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LONGICORN BEETLES FROM NEW GUINEA AND THE SOUTH PACIFIC

(Coleoptera: Cerambycidae)[1]

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PART I

This first installment[3] concerns members of the subfamilies Prioninae, Disteniinae and Cerambycinae principally from New Guinea and the Solomon, New Hebrides, Caroline and Marianas Islands. The material here reported on is from the California Academy of Sciences in San Francisco (C.A.S.), the American Museum of Natural History in New York (A.M.N.H.), the United States National Museum in Washington, D. C. (U.S.N.M.), the Hawaiian Sugar Planters' Association Experiment Station in Honolulu (H.S.P.A.) and the Taiwan Agriculture Research Institute in Taipeh, Formosa. The specimens were collected largely by members of the United States Armed Forces between 1943 and 1945, and also by Japanese entomologists between 1933 and 1942. Additional material in the American Museum of Natural History was taken on the 1936 Archbold Expedition, and at other times. Certain specimens are deposited in the Chicago Natural History Museum (C.M.N.H.) and the Lingnan Natural History Museum.

The material here reported upon was collected by T. Aarons, the Archbold Expedition, G. Banner, G. E. Bohart, the Crocker Expedition (A.M.N.H.), C. K. Dorsey, W. R. Enns, J. L. Gressitt, A. B. Gurney, E. Hagen, J. R. Helfer, H. Hoogstraal, P. L. Horton, T. Hosokawa, S. Issiki, S. G. Jewett, L. Macmillan, B. Malkin, F. Muir, C. E. Pemberton, E. S. Ross, L. W. Saylor, J. Shor, W. Stuber, S. Syuwaku, the Whitney Expedition, and R. G. Wind. I am also especially indebted

[1]Joint contribution from the California Academy of Sciences and the Lingnan Natural History Survey and Museum, Lingnan University.

[2]Research associate, California Academy of Sciences; associate professor of entomology, Lingnan University, and assistant entomologist, University of California, Division of Biological Control.

[3]See Gressitt, New longicorn beetles from islands in the Southwestern Pacific. Proc. Hawaiian Ent. Soc. 10 (3): 415–419, 1940.

to Dr. E. S. Ross, Dr. M. A. Cazier, Dr. E. A. Chapin, Mr. C. E. Pemberton and Mr. T. C. Maa of the first mentioned institutions, respectively, for their kindness in connection with the loan of this material.

Subfamily **Prioninae**

Tribe **Macrotomini**

1. **Archetypus fulvipennis** (Pascoe), 1859

One (A.M.N.H.), Guadalcanal I., Solomons, J. Shor.

2. **Olethrius tyrranus** Thomson, 1860

Several (A.M.N.H.), Espiritu Santo, New Hebrides, May 1944, G. Banner; Aniwa I., New Hebrides, Mar.-Apr. 1937, L. Macmillan; Florida I., Solomons, Whitney Exped.; Fiji Is.

3. **? Remphan hopei** Waterhouse, 1836

One (A.M.N.H.) questionably this species: Wom Lagoon, Fly River, Papua, Aug. 14, 1936.

4. **Xixuthrus microcerus axis** Thomson, 1877

Two (C.A.S.), Finschhafen, May 14, and Maffin Bay, Aug. 20, E. S. Ross, 1944, New Guinea.

A large reddish brown thinly pubescent species with ridges on the elytra and a number of short teeth bordering the prothorax; legs very spiny; antennae slender. Length 63–64 mm.

5. **Agrianome** (s. str.) **loriai** Gestro, 1893

Three (C.A.S.), Finschhafen, New Guinea, Apr. 30-May 2, 1944, E. S. Ross; two (H.S.P.A.), Babinda, N. Queensland, Sept. 1919, F. Muir.

A broad, depressed species, reddish brown with glabrous testaceous elytra; first and third antennal segments much longer than the others. Length 41–56 mm.

Tribe **Prionini**

6. **Osphryon pallidipennis,** new species

Female.—Pitchy black, slightly tinged with reddish, particularly on antennae; elytra pale testaceous, more brownish on bases and narrowly pitchy on borders. Body nearly glabrous above, with only a few short pale hairs on head and anterior part of pronotum, clothed with golden tawny pubescence on undersides of head and thorax and glabrous on antennae, legs and abdomen.

Head distinctly narrower than prothorax, a little longer than broad, finely and not very distinctly punctured; frons with a subtriangular concave area; vertex slightly raised at each side, rounded-concave; upper eye-lobes fairly close, with a groove between them. Antennae reaching barely to beginning of apical fourth of elytra, somewhat compressed and of similar breadth from third segment to apex; scape subtriangular, moderately stout distally, finely punctured, nearly

three-fourths as long as third segment; third not quite one-half again as long as fourth; fourth to last subequal in length; third slender and sparsely punctured basally, striate apically; fourth and following bearing fine raised striae as well as carinae on inner and outer edges, mostly truncate apically and hardly toothed or spined. Prothorax somewhat more than one-half as long as broad (including teeth), with four teeth at each side, the first two extremely small and the last two only a little longer than broad; disc somewhat flattened above, partly smooth and shiny, finely and not very closely punctured, a swelling at each side at top of lateral declivity slightly anterior to middle, bearing an angular impression on its upper surface; lateral declivities partly granulose. Scutellum parallel-sided basally, narrowly rounded at apex. Elytra a little more than twice as long as head and prothorax combined, subparallel, truncate apically with external angles rounded and a spine at each sutural angle; disc of each finely granulose basally, finely, shallowly and indistinctly punctured on remainder. Abdomen not distinctly punctured. Legs with hind femora barely reaching beyond middle of abdomen; femora partly toothed beneath; tarsi rather short. Length 34 mm.; breadth 10.8.

Holotype, female (A.M.N.H.), Fly River, 8 km. below Palmer River, Papua, May 23–31, 1936, Archbold Expedition.

Differs from *O. forbesi* Gah. in having the antennae not spined and entirely pitchy, with the bases of third to fifth segments not shiny, and the elytra spined only at sutural angles.

KEY TO THE SPECIES OF OSPHRYON

1. Scape unspined 2
   Scape spined . . . . . **spiniscapus** Schw.
2. Antennae with third segment not much longer than each of following 3
   Antennae with third segment about twice as long as each of following 4
3. Third and following antennal segments strongly spined both internally and externally; each elytral apex with two teeth . . . . . **forbesi** Gah.
   Third and following antennal segments not spined or toothed internally or externally; each elytral apex with a single sutural spine . . **pallidipennis** Gress.
4. Head and pronotum distinctly pubescent above 5
   Head and pronotum very sparsely pubescent; eyes very close above; elytral apices rounded externally and spined only at suture . . . . . **adustus** Pasc.
5. Elytra finely granulose, blackish brown . . . . . **granuliger** Auriv.
   Elytra densely punctured, yellowish testaceous . . . . . **hirticollis** Gah.

Subfamily **Disteniinae**

7. **Distenia bougainvillea,** new species

Female.—Slender; body black to purplish brown; antennae and legs testaceous and purplish brown; head and prothorax purplish black; palpi testaceous; antennae ochraceous, purplish brown on apical third of scape and apical fifth or so of each of third to tenth segments; elytra purplish brown clothed with close but thin golden pubescence; ventral surfaces pitchy brown to red brown, moderately pubescent; legs testaceous with coxae reddish, almost apical halves of femora purplish brown, apical tenths of tibiae purplish black and apical portions of tarsal segments and a ring near middle of each tibia pale purplish brown.

Head broader than prothorax at base, finely grooved and feebly punctured between upper lobes of eyes. Antennae three-fourths again

as long as body; scape reaching nearly to middle of prothorax, about as long as third segment; third to fifth subequal in length, following gradually diminishing in length. Prothorax broader than long; each side with a large obtuse tubercle terminating in a small, acute, conical process directed somewhat posteriorly; disc bearing a prominent blunt tubercle on each side before middle, a more obtuse, less prominent one on each side behind middle, and a flat, slightly raised area between latter; surface practically impunctate, satiny. Scutellum scutiform. Elytra gradually narrowed to apical eighth, then more strongly narrowed, truncate at suture and acutely dentate apically; disc of each with about eight subregular longitudinal rows of deep punctures at end of basal quarter, densely punctured below humeri; puncture-rows disappearing suddenly before or after middle. Metasternum shallowly punctured at sides. Legs rather slender; femora slightly clavate, hind femur feebly fusiform, not quite reaching elytral apex; tibiae feebly sinuate; hind tarsus with first segment equal to following two united. Length 14 mm.; breadth 3.2.

Male.—Antennae two and one-fourth times as long as body; antennal segments briefly darkened apically; tibiae without dark rings at middle; each elytron narrowed to a point apically, but untoothed. Length 18 mm.; breadth 4.6.

Holotype, female (No. 58348, U.S.N.M.), Bougainville I., Solomon Is., 1944, Dr. A. B. Gurney; *allotype*, male (A.M.N.H.), Malaita I., Solomon Is. (Ac. 30985).

Differs from *D. pryeri* Pascoe, of Borneo, in being submetallic instead of entirely brown with pale pubescence, and in having each elytron with one instead of two apical spines.

Subfamily **Cerambycinae**

Tribe **Oemini**

8. **Xystrocera apiculata** Pascoe, 1869

Three (C.A.S. & C.M.N.H.) Hollandia, northern New Guinea, Dec. 2 and 15, 1944, H. Hoogstraal.

Tawny brown; antennae, legs, ventral surfaces and borders of prothorax and elytra pitchy brown; antennae with many small spines. Length 15–34 mm.

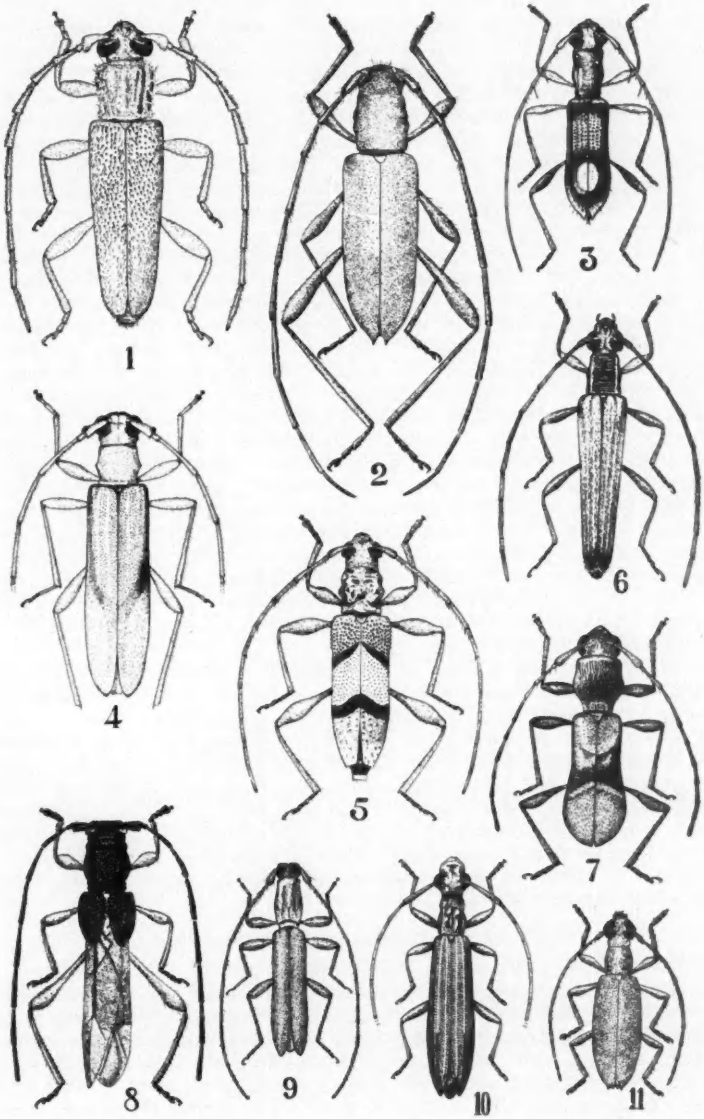
9. **Hyphus comusioides,** new species

Plate I, fig. 4

Male.—Pale testaceous to pitchy: head and antennae ochraceous; prothorax testaceous on disc, pitchy brown at sides and darker beneath;

EXPLANATION OF PLATE I

FIG. 1. *Ceresium amplicolle*, n. sp. × 2.7. FIG. 2. *Tethionea hoogstraali*, n. sp. × 3.5. FIG. 3. *Iphrobrium spinipenne*, n. sp. × 4.2. FIG. 4. *Hyphus comusioides*, n. sp. × 5.4. FIG. 5. *?Nyphasia pulchra*, n. sp. × 2.7. FIG. 6. *Uracanthus declivis*, n. sp. × 2.7. FIG. 7. *Iphra euderceoides*, n. sp. × 8.4. FIG. 8. *Epania rufipes*, n. sp. × 4.2. FIG. 9. *Tetraommatus rossi*, n. sp. × 5.4. FIG. 10. *Syllitus sexlineatus*, n. sp. × 4.6. FIG. 11. *Tethionea tenuimembris*, n. sp. × 3.5.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scutellum ochraceous, slightly pitchy along borders; elytra pale ochraceous anteriorly and testaceous posteriorly, each with a dark pitchy lateral stripe from humerus to just behind middle with an oblique branch across middle and extending posteriorly along suture, while becoming paler, and ending some distance from apex; ventral surfaces pitchy at sides, and reddish along middle, of hind thorax; abdomen and legs pale testaceous. Body moderately clothed with short oblique or adpressed pale hairs, longer and less oblique on antennae and legs.

Head slightly broader than, and about as long as, prothorax, finely and not very closely granulose; frons higher than wide, broader above, feebly depressed medially; vertex obtusely concave between antennal insertions, followed by a central depression; occiput convex, with a feebly depressed median line; eyes large, about as widely separated above as below; genae very narrow; maxillary palpi long and slender, distal segment about twice as long as penultimate. Antennae longer than body, slender; scape subcylindrical, two-thirds as long as third segment, bearing some arcuate raised blade-like structures near apex; third and following segments subequal. Prothorax a little broader than long, slightly widened at middle with a short obtuse tubercle at middle of each side, and with a moderate constriction near base; disc rather even, minutely granulose. Scutellum even, narrowed and rounded-truncate posteriorly. Elytra subparallel-sided, very feebly widened at middle; apices separately rounded-obtuse; disc of each with two fine slightly oblique raised lines and numerous small irregular punctures on basal half. Ventral surfaces minutely punctured or finely granulose. Legs slender; femora strongly flattened, hind pair not nearly reaching elytral apices; first hind tarsal segment longer than remaining combined. Length 8 mm.; breadth 1.88. Paratype, length 7.8 mm.; breadth 1.5.

Female.—Length 9.8 mm.; breadth 1.85.

Holotype, male (C.M.N.H.), Hollandia, northern New Guinea, May 1945, Harry Hoogstraal; *allotopotype*, female (C.A.S.), same data; *paratopotype*, male (C.A.S.) Apr. 1, 1945, S. G. Jewett.

Differs from *H. aurantiacus* Pascoe, of Celebes, in lacking tubercles on the disc of the pronotum, in having the dorsal surface distinctly pubescent and the elytra with dark lateral borders in anterior half and with an oblique dark band on each near middle. Similar in appearance to *Comusia obriumoides* Th., of the Philippines, but with the front of the head vertical and the fourth antennal segment as long as third and fifth. The paratype has the elytra less distinctly pigmented than do the other two specimens.

10. **Tetraommatus rossi,** new species

Plate I, fig. 9

Male.—Testaceous, more reddish on head, antennae (except distal portions), prothorax and ventral surfaces; pronotal disc with a pair of narrow sublongitudinal stripes from near apex to near base, each being feebly arcuate and most closely approaching the other at middle. Body largely clothed with short oblique reddish buff hairs, shorter and less raised on head and prothorax than on antennae, elytra and legs, sparsely clothed on ventral surfaces.

Head distinctly broader than prothorax, much broader than long,

nearly vertical and feebly convex in front, distinctly, and not very closely, punctured; vertex feebly concave between antennal insertions; superior eye-lobes large, closely adjacent, widely separated from inferior lobes, subrounded; inferior eye-lobes subrounded, each about as large as frons and one-half again as large as superior lobe; genae very short. Antennae nearly one-fourth longer than body, slender; scape swollen apically, three-fifths as long as third segment, hardly twice as long as second; third barely longer than fourth; following gradually shorter. Prothorax twice as broad as long, nearly parallel-sided, very slightly broadened behind middle, moderately constricted near base, with constriction forming an incision at each side; disc finely granulose-punctate, finely grooved medially behind center; constricted basal portion smooth and paler. Scutellum nearly twice as long as broad, narrowed and elliptical posteriorly. Elytra narrow and parallel-sided, separately obtusely rounded apically; discs finely and closely punctured, partly in incomplete transverse or oblique rows. Ventral surfaces sparsely and irregularly punctured. Femora strongly flattened, finely punctured, hind pair not nearly approaching elytral apices; tibiae slender and straight; tarsi very slender, hind pair with first segment much longer than remaining segments combined. Length 5.3 mm.; breadth 0.95. Paratype: Lacking the two black stripes on pronotum. Length 5.95 mm.; breadth 1.

Holotype, male (C.A.S.), Finschhafen, northern New Guinea, Apr. 12, 1944; ***paratopotype***, male (C.A.S.), Apr. 17; both taken by Dr. E. S. Ross.

Differs from *T. ocularis* Pascoe in being more slender, in having the upper eye-lobes more closely approximated, the prothorax fully twice as long as broad, more parallel-sided, more reddish and marked with pitchy. Dedicated to my friend Dr. E. S. Ross, Curator of Insects, California Academy of Sciences, as a slight token of gratitude for many kindnesses.

11. **Tetraommatus ocularis** Pascoe, 1869

One (C.A.S.) Hollandia, northern New Guinea, Apr. 17, 1945, Harry Hoogstraal.

Entirely pale testaceous except for the four black eyes; prothorax not quite twice as long as broad, flat above, untoothed, feebly convex laterally. Length 4.7 mm.; breadth 0.9.

Tribe **Cerambycini**

12. **Aeolesthes ampliata** Gahan, 1890

One (C.A.S.) by the Tenaru River, Guadalcanal I., Solomon Is., Jan. 1945, G. E. Bohart.

Dark brown with close golden pubescence lying in different directions; intergenal groove straight; prothorax rugulose; elytra each with two apical spines. Length 33 mm.; breadth 9.5.

13. **Aeolesthes induta** (Newman), 1842

Two (C.A.S.) Maffin Bay, Aug., E. S. Ross; Hollandia, Oct. 3, T. Aarons, northern New Guinea, 1944.

Similar to the preceding but with the outer tooth at apex of each elytron triangular, the intergenal groove arched posteriorly. Length 27–29 mm., male and female.

14. **Calocerambyx hauseri** Heller, 1905

Two (C.A.S. & C.M.N.H.) Hollandia, northern New Guinea, Dec. 13 and 22, 1944, Harry Hoogstraal.

Reddish brown, clothed with close whitish pubescence except for some minute glabrous spots on bases of elytra and larger ones behind middle; prothorax transversely ridged; head with several prominent processes.

15. **Hoplocerambyx brevispinis,** new species

Female.—Pitchy black, elytra pitchy purplish black, ventral surfaces reddish pitchy in part; femora reddish, except for black at extreme apices. Eyes, prothorax and scutellum fringed with largely recumbent golden hairs, nearly covering scutellum; antennae with extremely fine pale pubescence, ventral surfaces with scattered pale hairs.

Head narrower than prothorax, longer than broad, flattened, depressed on each side of middle of frons, with five grooves of different magnitude between antennal insertions, a discontinuous median ridge between upper eye-lobes, and postocciput asperate. Antennae slightly longer than body, scape irregularly transversely wrinkled, about as long as third segment, third nearly one-half again as long as fourth, subequal to fifth, sixth longer than fifth, sixth to ninth subequal; fifth to tenth briefly spined endoapically and sixth to tenth briefly toothed ectoapically; sixth to last somewhat flattened, particularly on outer side. Prothorax broader than long, widest at middle, constricted before apex, coarsely vermiculate on disc, the vermiculation mostly transverse, and with a subpentagonal isolated area in center, preceded by two subapproximated tubercles behind anterior constriction. Scutellum short, rounded. Elytra subparallel, obliquely truncate at sutural corners, rounded externally; surface very finely and sparsely punctured on basal half except on extreme bases. Ventral surfaces largely impunctate. Legs long, femora almost parallel-sided; first hind tarsal segment hardly as long as second and third. Length 37 mm.; breadth 10.85. Paratype, length 41 mm.; breadth 13.

Holotype, female (No. 58353, U.S.N.M.), Peleliu I., Palau Group, 1945, C. K. Dorsey (45–10658); *paratype*, female (Taiwan Agr. Res. Inst.), Palau Is., Sept. 9-Oct. 19, 1933, T. Hosokawa.

Differs from *H. spinicornis* (Newm.) in not being grooved medially between the eyes, in having the second and third antennal segments unspined, the prothorax broader, the elytra less pubescent and less spined apically, and with more even surfaces.

16. **Hoplocerambyx severus** Pascoe, 1869

One (A.M.N.H.) Oro Bay, New Guinea, Febr.-May, P. L. Horton.

Tribe **Hesperophanini**

17. **Stromatium longicorne** (Newman), 1842

One (A.M.N.H.) Tarara, Papua, Dec. 16, 1936.

Tribe **Phoracanthini**

18. **Coptocercus biguttatus** (Donovan), 1805

Three (C.A.S. & C.M.N.H.) Hollandia, northern New Guinea, Dec. 13, 1944 and Apr. 17, 1945, Hoogstraal; Hollandia, Apr. 1, 1945, Jewett; (A.M.N.H.) Oro Bay, New Guinea, Oct. 1943-Jan. 1944, J. R. Helfer.

Slender; reddish brown with raised ivory-like areas on elytra; femora pedunculate-clavate. Length 12.5 mm.

19. ? **Coptocercus crucigera** (Hope), 1841

One (A.M.N.H.), questionably this species: Lake Daviumbu, Fly River, Papua, Aug. 19–30, 1936, Archbold Exped.

20. ? **Nyphasia pulchra,** new species

Plate I, fig. 5

Female.—Rich reddish ochraceous; elytra crossed at middle by a very broad pale yellow chevron-shaped band, conspicuously edged before and behind with black, the posterior black border a little wider; head, prothorax and scutellum with golden pubescence giving changing appearances of shading depending on light and contour; antennae thinly clothed with pubescence and with strong oblique hairs beneath; elytra with little pubescence and few erect hairs; legs and ventral surfaces of body moderately clothed with golden buff pubescence and a few scattered suberect hairs.

Head about as long, and nearly as broad, as prothorax, oblique, feebly raised at antennal insertions, minutely punctulate to finely granulose; frons rectangular, transverse, with a fine median line and a small median apical smooth area; vertex broad and shallowly concave; occiput with a shallow transverse depression immediately behind the distant superior eye-lobes; eyes large, deeply emarginate; genae one-fourth as deep as inferior eye-lobes. Antennae slightly longer than body, somewhat flattened; third to sixth segments spined endoapically and seventh to tenth segments briefly angulate ectoapically; scape swollen, finely punctured, two-thirds as long as third segment; fourth segment slightly shorter than fifth, which again is not quite as long as third; fifth and following gradually decreasing. Prothorax about as broad as long, sinuate at sides with a broad rounded tubercle at middle of each side and a lateral swelling between it and apex; disc with five conspicuous rounded tubercles, forming an "M", the median one somewhat elongate, the anterior two slightly closer together than posterior two, and in addition a smaller sublateral tubercle between lateral two of disc and lateral tubercle, and another less distinct one behind it; surfaces finely and sparsely punctured. Scutellum rounded triangular. Elytra parallel-sided, narrowed and subobliquely truncate apically; disc of each strongly asperate-punctate on basal reddish third, moderately punctured on middle yellowish third and finely and sparsely punctured on apical third, the asperate punctures largely separated by less than a puncture-diameter and most of the punctures on middle section separated by less than a puncture-diameter. Ventral surfaces not distinctly punctured. Legs sparsely punctured; femora strongly pedunculate-clavate, hind

pair reaching elytral apices; first hind tarsal segment about as long as next two combined. Length 13.6 mm.; breadth 3.3.

Holotype, female (A.M.N.H.), Lake Daviumbu, Fly River, Papua, New Guinea, Aug. 19–30, 1936, Archbold Expedition.

Differs from typical members of the genus in having the distal segment of each palp flattened and narrowly triangular, the antennal supports less raised and the front coxal cavities not quite closed behind. Differs from *pascoei* Lac. in having the pronotum more tuberculate and the elytra contrastingly banded and asperate basally.

Tribe **Callidiopini**

21. **Cylindera flava** (Fabricius), 1775

One (A.M.N.H.) Taio Hae Bay, Nuku Hiva I., Oct. 1934, Crocker Exped.; another (C.A.S.) Bonin Is., from Gressitt collection.

22. **Ceresium amplicolle,** new species

Plate I, fig. 1

Female.—Reddish to castaneous: head and antennae reddish castaneous, scape slightly paler; prothorax reddish castaneous, darker on depressed areas; elytra castaneous, paler posteriorly and darker along suture behind scutellum; ventral surfaces and legs partly paler reddish. Body irregularly clothed with pale tawny hairs: somewhat densely on parts of head and prothorax, but sparser to subglabrous on raised areas of vertex, occiput and pronotum; elytra sparsely clothed with recumbent stouter hairs lying in different directions; ventral surfaces with dense, finer, more oblique hairs; legs more sparsely clothed.

Head practically as broad as prothorax, sparsely punctured or impunctate; frons short, subdeclivitous, obliquely depressed from middle of upper portion to each side, medially grooved above; vertex broadly raised, grooved medially to between upper eye-lobes, which are much closer than lower lobes; occiput largely impunctate and glabrous. Antennae about one-sixth longer than body, fairly stout, flattened and serrate externally; scape strongly arched and swollen, slightly longer than third segment; fourth slightly shorter than third; fifth longer than second and third combined; fifth to tenth subequal; last longest. Prothorax very stout and convex, about as broad as long, not much narrower than elytra; subparallel-sided, but slightly constricted a short distance from base, broadened to anterior to middle, and suddenly narrowed at apex, which is much narrower than base; disc inflated, with several incomplete longitudinal raised smooth areas separated by broad, coarsely punctured depressed areas; a broad raised area on each side anteriorly with a smaller, more protruding node below it, a median raised strip which broadens posteriorly, and an oblique one on each side of basal half, turning inward near base to form a common transverse ridge bordered anteriorly by a similarly shaped depression; sides irregularly punctured, partly rugose. Scutellum short, triangular. Elytra broad, narrowed posteriorly, rounded-truncate apically; disc of each heavily and sparsely subfoveate-punctate on basal half, finely and sparsely punctured posteriorly. Ventral surfaces finely punctured. Legs stout; femora moderately swollen, hind pair falling considerably short of

elytral apices; first hind tarsal segment shorter than next two combined. Length 16 mm.; breadth 4.35.

Holotype, female (A.M.N.H.), Sturt Island, Fly River, Papua, Oct. 14–16, 1936, Archbold Expedition.

Differs from most *Ceresium* in having the antennae flattened and serrate and the prothorax broad, subrectangular and coarsely ridged. Differs from *C. pachymerum* (Pasc.) by the above characters, and in having the elytra very coarsely punctured and the legs shorter with the femora less swollen.

23. **Ceresium cylindricellum,** new species

Female.—Ochraceous to castaneous, shiny: head and prothorax reddish brown, latter castaneous anteriorily; elytra paler reddish brown; thoracic sterna castaneous; abdomen paler reddish; legs reddish ochraceous. Body sparingly clothed with fine recumbent pale hairs, irregular on head and prothorax, regular on elytra but denser posteriorly, finer and closer on thoracic sterna, longer and oblique on tibiae, rather short and oblique on undersides of antennae.

Head fully as broad as prothorax and nearly as long, irregularly but deeply punctured; squarish but with sides constricted by eyes, finely grooved medially; vertex feebly raised at sides, slightly concave; upper eye-lobes barely closer than lower, but not much closer than antennal insertions; eyes almost as close on underside of head as on frons; genae minute. Antennae slightly longer than body, slender; scape slender, slightly arched, barely longer than second and third segments combined; fourth a little shorter than third; fifth about as long as scape; following very slightly diminishing in length. Prothorax a little longer than broad, subcylindrical, feebly and evenly convex at sides, practically as broad at apex as at base; disc feebly convex, fairly even, with three longitudinal feebly raised impunctate stripes extending forward from base to well beyond middle, the lateral ones less regular, becoming broader and partly punctured anteriorly, remainder moderately punctured, with the punctures mostly about as wide as interspaces. Scutellum small, rounded triangular. Elytra distinctly broader than prothorax, parallel-sided, conjointly rounded apically with a slight dehiscence; disc of each subevenly punctured, the punctures about as large as interspaces anteriorly and becoming minute posteriorly. Ventral surfaces feebly punctured. Legs slender and rather short; femora feebly swollen, hind pair hardly three-fourths as long as abdomen; first hind tarsal segment about as long as next two combined. Length 7.25 mm.; breadth 1.6. Paratype, length 5.85 mm.; breadth 1.5.

Holotype, female (C.M.N.H.), Hollandia, northern New Guinea, May 1945, Hoogstraal; *paratopotype* of same sex (C.A.S.), Apr. 17.

Differs from *C. sinicum* Wh. in being smaller, more cylindrical, with the eyes closer, the prothorax more cylindrical, more even, and with three subparallel low ridges posteriorly, the elytra more finely punctured posteriorly and the femora more slender.

24. **Ceresium discicolle,** new species

Male.—Shiny reddish brown to pitchy: head pitchy black with mouthparts reddish; antennae reddish; prothorax pitchy brownish black,

shiny; elytra dark reddish brown, paler posteriorly; ventral surfaces reddish tinged with pitchy in part; legs reddish brown. Body clothed with tawny hairs, scattered on head and sides of prothorax, very dense around sides of pronotal disc, which is completely glabrous on a large rounded-keystone shaped area covering much of disc, longer, sparser and less recumbent on elytra, both recumbent and suberect, and denser, on ventral surfaces, sparser and more erect on legs.

Head narrower than prothorax, rugose-punctate; frons transverse; vertex raised at sides, evenly concave and somewhat grooved medially; occiput raised medially near posterior borders of eyes; upper eye-lobes closer than lower lobes; genae short. Antennae slightly longer than body; scape fairly large, longer than third segment; fourth nearly as long as third; fifth slightly longer than third; fifth and following subequal. Prothorax about as long as broad, gradually broadened from base towards apex, then suddenly narrowed with apex distinctly narrower than base; disc smooth, with only a very few shallow punctures on glabrous area; sides coarsely rugose-punctate. Scutellum short, rounded behind. Elytra narrowed posteriorly, obtusely rounded apically; disc of each deeply and strongly punctured on basal portion, with about 12 punctures in a rough row transversely somewhat behind humerus, most of them much larger than interspaces, but becoming minute posteriorly. Ventral surfaces vaguely punctured. Legs stout with femora strongly swollen, the hind pair falling considerably short of elytral apices; first hind tarsal segment a little shorter than next two combined. Length 11.9 mm.; breadth 3.05.

Female.—Antennae slightly shorter than body; hind femora two-thirds as long as abdomen. Length 13.5–14.5 mm.; breadth 5.3–5.5.

Holotype, male (A.M.N.H.), Palmer River at Black River, Papau, June 7–14, 1936, Archbold Expedition; *allotype*, female (A.M.N.H.), Fly River 8 km. below Palmer River, Papua, May 23–31, 1936, Archbold Exped., *paratype*, female (C.A.S.), Fly River below Palmer River, May 14–22.

Differs from *C. pachymerum* (Pasc.) in having the hind femora distinctly shorter than elytra in both sexes, the legs less swollen, the antennae shorter, the pronotal disc with a larger and smoother central glabrous area, and in being smaller.

25. **Ceresium flavipes** (Fabricius), 1792

One (Taiwan Agr. Res. Inst.) Manokwari, N. W. New Guinea, Nov. 15, 1942, S. Syuwaku.

26. **Ceresium guttaticolle** Fairmaire, 1850

Some referable to this, which I am not convinced is distinct from *unicolor* (Fabr.): (Taiwan Agr. Res. Inst.) Yap I., Caroline Is., July 1937, T. Hosokawa; (C.A.S.) Pt. Oca, Guam, May-June, 1945, G. E. Bohart & J. L. Gressitt; and Saipan I., Marianas Is., E. Hagen.

27. **Ceresium unicolor** (Fabricius), 1787

C. palauense Matsushita is very likely a synonym of this.

Several (A.M.N.H.) Agana, Guam, June-July (Ac. 22628); Malaita, Solomon Is. (Ac. 30985); also Nuku Hiva I. & Pepete, Tahiti; Moorea,

Society Is., & Kawai, Hawaii; (Taiwan Agr. Res. Inst.) Saipan I., Marianas Is., July 1939, S. Issiki.

28. **Ceresium validipes** Fairmaire, 1883

Several (A.M.N.H. & C.A.S.) Hollandia, New Guinea, Dec. 1933, W. Stuber, Febr.-Mar. 1945, S. G. Jewett; (A.M.N.H.) Oro Bay, Jan. & Lae, Mar-Apr. 1944, J. R. Helfer; Sturt Island, Fly River, Papua, Oct. 14, 1936, Archbold Exped.; (H.S.P.A.) Koitaki, 1500 ft., New Guinea, Oct.-Nov. 1928, C. E. Pemberton. Some (A.M.N.H.) questionably this species: Palmer River at Fly River, June 1936, Archbold Exped. and Malaita, Solomon Is. (Ac. 30985).

KEY TO SOME NEW GUINEA SPECIES OF CERESIUM

1. Elytra and antennae testaceous to pitchy reddish 2
   Elytra greenish posteriorly; first five antennal segments and much of legs greenish ..... **virens** Heller
2. Elytra more or less evenly pubescent, though generally sparsely so 3
   Elytra pubescent with two longitudinal series of glabrous spots on each; prothorax somewhat obtusely angulate at middle of each side. . **leprosum** Auriv.
3. Prothorax rather stout, somewhat parallel-sided, but broadened anterior to middle and still quite broad close to apex, then suddenly narrowed; elytra gradually narrowed posteriorly 4
   Prothorax longer than broad, or about as long as broad, subevenly convex at sides, not broadened anteriorly and not rather broad very close to apex; elytra subparallel-sided; femora generally pale 5
4. Antennae distinctly flattened and somewhat serrate; prothorax very stout with longitudinal raised and depressed, coarsely punctured areas, **amplicolle** Gress.
   Antennae not flattened or serrate; prothorax not extremely stout, bearing a large smooth glabrous impunctate dark keystone-shaped area on disc ..... **discicolle** Gress.
5. Length more than 11 mm.; femora yellowish testaceous; pronotum without three longitudinal smooth strips closer together than their lengths 6
   Length less than 8 mm.; femora reddish ochraceous; prothorax narrow, subcylindrical, its disc bearing three longitudinal smooth strips which are closer together than their lengths ..... **cylindricellum** Gress.
6. Prothorax fully as broad as long, shallowly and not very densely punctured, irregularly pubescent; elytra conjointly about 2.5 times as long as broad ..... **flavipes** (Fabr.)
   Prothorax longer than broad, deeply and rugulosely punctured, subregularly pubescent; elytra conjointly about 2.85 times as long as broad, **validipes** Fairm.

29. **Examnes dimorpha,** new species

Male.—Pale reddish brown, slightly shiny; darker reddish brown on prothorax; nearly testaceous on abdomen and legs; posterior portions of elytra paler than head and antennae. Body irregularly clothed with oblique buff hairs: sparse on head, lacking on finely punctured parts of prothorax, sparse and partly longer on antennae, short on elytra, very sparse on ventral surfaces and fairly sparse on legs.

Head slightly broader than prothorax, fairly deeply and closely punctured; frons short, vertical; vertex transversely raised, slightly concave and finely grooved along middle; upper eye-lobes separated by less than one-half distance between lower lobes, which are subtriangular; genae minute. Antennae nearly two-thirds again as long as body, slender and tapering; scape less than two-thirds as long as third segment, moderately swollen in middle; fourth slightly longer than scape; fifth as

long as third; following gradually shorter. Prothorax fully one-third again as long as broad, slightly and subsinuately rounded at sides, as broad at apex as at base; disc very finely and closely punctured except for a subrectangular area on slightly more than basal half, a little longer than broad, which is much more coarsely punctured and bears three longitudinal smooth ridges, the median one continuing to near anterior margin and ending in a triangular more sparsely punctured area. Scutellum as long as broad, narrowed and rounded apically. Elytra long and gradually narrowed, rounded apically; disc of each rather finely and evenly punctured, the punctures mostly one-half as wide as interspaces and finer posteriorly. Ventral surfaces somewhat sparsely punctured. Legs moderately long; femora broadened and flattened, hind pair slightly exceeding elytral apices; tibiae straight; first hind tarsal segment slightly longer than next two combined. Length 10.7 mm.; breadth 2.35.

Female.—Antennae one-third longer than body; prothorax no longer than broad, distinctly convex at sides, subregularly punctured with punctures similar to those of elytral bases, and with a low median impunctate strip and some slightly raised, less punctate areas on each side of middle and on each side of base; hind femora falling considerably short of elytral apices. Length 9.6 mm.; breadth 2.3.

Holotype, male (A.M.N.H.), Vila, Efate, New Hebrides, Nov. 1943, W. R. Enns; *allotopotype*, female (A.M.N.H.), June 1943; *paratopotype*, female (C.A.S.), Nov. 1943.

Differs from other members of the genus in having dimorphism in the form of elongated and differently punctured prothorax in the male, unless by chance two species have been confused as one. However, the other characters seem to agree closely. Differs from *philippensis* (Newm.) in being much smaller, more slender, with more slender antennae, and in having longer and much more finely punctured prothorax in the male and more slender and paler femora.

30. **? Examnes longipes,** new species

Male.—Dull reddish brown, opaque; antennae, abdomen and legs more reddish and slightly shiny. Body moderately clothed with fine subrecumbent buff hairs, longer, finer and more recumbent on head and prothorax, shorter, heavier, more oblique and more regular on elytra, much denser on sides of metathorax, longer and more erect on tibiae; a few scattered suberect hairs on undersides.

Head narrower and shorter than prothorax, granulose-punctate, medially grooved to between upper eye-lobes; frons short, almost vertical, with a roundish cavity on each side; vertex transversely raised, shallowly concave at middle; upper eye-lobes somewhat closer than lower lobes, which are subtriangular; genae minute. Antennae nearly twice as long as body, slender and distinctly tapering; scape feebly swollen, regularly punctured, three-fourths as long as third segment; fourth slightly shorter than scape; fifth one-third longer than third; following very slightly diminishing in length. Prothorax about as broad as long, slightly and evenly convex at sides, barely narrower at apex than at base; disc shallowly and not very densely punctured, with a feeble transverse raised line anterior to middle, and a few oblique ones

at sides of disc, partly accentuated by meeting of areas with hairs facing towards those of the other. Scutellum a little broader than long, rounded behind. Elytra barely twice as long as head and prothorax combined, slightly broader than prothorax, slightly narrowed posteriorly and separately obtusely subrounded; disc of each rather closely and uniformly punctured with irregular punctures mostly smaller than interspaces and becoming smaller posteriorly. Ventral surfaces finely punctured. Legs fairly slender; middle and hind femora feebly swollen, hind pair exceeding elytral apices by fully one-third their length; first hind tarsal segment as long as next two combined. Length 9.5 mm.; breadth 2.4. Paratype, length 6 mm.; breadth 1.35.

Female.— Antennae about three-fifths again as long as body; prothorax slightly broader than long, with a feeble longitudinal raised line at center; hind femora barely exceeding elytral apices. Length 9.6 mm.; breadth 2.55.

Holotype, male (C.M.N.H.), Hollandia, northern New Guinea, Dec. 13, 1944, Harry Hoogstraal; *allotopotype*, female (C.A.S.) Nov. 22; *paratopotype*, male (Lingnan N. H. Mus.), Nov. 21; additional (C.A.S.), all taken by Hoogstraal.

Differs from the known species in the shorter build, very slender antennae and long slender femora. Differs from *E. frontalis* Pasc. in being much smaller, with the body hairs much less erect, the dorsum finely punctured, the femora very slender and without erect hairs, etc.

31. **Examnes philippensis** (Newman), 1842

Some (Taiwan Agr. Res. Inst.) Manokwari, N.W. New Guinea, Aug. 1936, S. Issiki; (C.A.S.) Hollandia, New Guinea, Apr. 1945, S. G. Jewett.

32. **Tethionea brevicollis,** new species

Female.—Reddish castaneous, somewhat shiny, paler on head and prothorax, darker on elytra; antennae, legs and abdomen reddish testaceous; thoracic sterna slightly darker. Body nearly glabrous above except for a few suberect reddish hairs on head and on caudal ends of elytra; ventral surfaces and legs sparsely clothed with suberect pale hairs, sparsest on femora.

Head nearly as broad as, and slightly longer than, prothorax, very minutely punctured; frons transverse, nearly plane, feebly depressed medially; vertex shallowly concave, medially grooved; superior eye-lobes somewhat closer than inferior lobes; inferior lobes rounded-triangular; genae one-fifth as deep as inferior lobes. Antennae one-sixth longer than body, slender; scape feebly thickened, barely longer than second and third segments combined; fourth slightly shorter than scape and than fifth; following gradually decreasing. Prothorax distinctly broader than long, obtusely rounded at sides, minutely and irregularly punctured, with a faint longitudinal swelling on each side of center. Scutellum fully as long as broad, narrowed and rounded behind. Elytra parallel, narrowed and separately rounded apically; disc of each deeply but not very heavily punctured in about 16 partly subregular rows, more confused near borders, with two partly raised lines along central portion. Ventral surfaces not very distinctly punctured. Legs with femora

rather stout, hind pair three-fourths as long as abdomen; first hind tarsal segment as long as next two combined. Length 6.9 mm.; breadth 1.9.

Holotype, female (C.M.N.H.), Hollandia, northern New Guinea, Apr. 17, 1945, Hoogstraal; *paratopotype*, female (C.A.S.), Dec. 24, 1944, Hoogstraal.

Differs from the other members of the genus in having the prothorax distinctly broader than long and the elytra evenly rounded apically. Further differs from *T. unicolor* in having the antennal supports more depressed and the elytral puncturation more lineate and continuing more posteriorly.

33. **Tethionea hollandiae,** new species

Female.—Shiny reddish brown marked with pitchy: head reddish, palpi darker; antennae reddish brown; prothorax shiny reddish brown, becoming pitchy brown at sides; scutellum and elytra reddish brown, latter marked with pitchy along external margin and with an oblique line on each just behind middle, going posteriorly towards suture, the apices also pitchy; ventral surfaces pitchy red on thorax and pale reddish on abdomen; legs pitchy red on femora and ochraceous on tibiae and tarsi. Body largely glabrous: a few scattered suberect hairs on dorsal surfaces, abdomen and legs; mesothorax and sides of metathorax with very thin silky gray pubescence; prothorax nearly glabrous.

Head about as broad as prothorax, finely and not very closely punctured, though more closely so on neck; vertex feebly concave, smooth medially; eyes hardly closer above than below; genae minute. Antennae one-sixth longer than body; scape gradually thickened, arched, irregularly punctured, a little longer than third segment; fourth a little shorter than third; fifth slightly longer than scape; following gradually shorter. Prothorax barely longer than broad, evenly and feebly convex at sides, deeply and very closely punctured above and at sides, with a bare suggestion of a median impunctate line only near base. Scutellum semicircular. Elytra narrowed at apex of each into a long acuminate tooth with an arcuate emargination on inner side of each to the very briefly toothed sutural angle; surfaces rather strongly punctured on basal two-thirds, then suddenly becoming sparsely and feebly punctured, with apical portions impunctate but finely wrinkled. Ventral surfaces somewhat punctured at sides. Hind femora somewhat gradually swollen, reaching elytral apices; hind tarsi slender, first segment a little longer than next two combined. Length 8.5 mm.; breadth 2.

Holotype, female (C.M.N.H.), Hollandia, northern New Guinea, May 6, 1945, Hoogstraal; five *paratypes* (C.A.S. & Lingnan), Dec. 24, 1944, Feb. 10, 22, and Apr. 22, 1945, Hoogstraal.

Differs from *T. unicolor* Pasc. in being smaller, in having the prothorax more densely punctured and without any lateral irregularity, the elytral punctures becoming suddenly reduced and the inner side of each apical spine emarginate instead of oblique.

34. **Tethionea hoogstraali,** new species

Plate I, fig. 2

Male.—Pale reddish castaneous, shiny, more ochraceous on posterior

portions of elytra; meso- and metathorax deeper reddish, nearly pitchy at sides; abdomen and femora pale ochraceous; tibiae and tarsi a little more reddish. Body very sparingly clothed above with a few suberect amber hairs; antennae moderately clothed with strongly oblique to suberect pale hairs of different lengths; ventral surfaces sparsely clothed with suboblique tawny hairs and with some thin pale pubescence on sides of hind thorax; legs sparsely clothed with oblique tawny hairs.

Head nearly as broad and practically as long as prothorax, irregularly punctured; frons short, subvertical, transversely depressed; vertex somewhat raised, feebly concave, slightly grooved medially, largely impunctate; occiput with scattered punctures; neck more closely punctured; upper eye-lobes closer than lower lobes. Antennae over one-half again as long as body, slightly widened and compressed; scape as long as second and third segments combined; fourth barely longer than third, barely three-fourths as long as fifth; fifth and following subequal. Prothorax about as broad as long, irregular at sides, about as broad at apex as at base, and hardly any broader at middle; each side with two impunctate swellings before middle, anterior one hardly raised, and a punctured elongate tubercle on upper part of side not far from base; disc irregularly punctured, hardly convex, with a partial raised median line and an arcuate depressed area on each side of basal portion, edged externally with an arcuate raised area terminating in a slight swelling above middle of each side; sides more deeply and densely punctured than most of disc, with punctures mostly nearly as large as interspaces. Scutellum a little broader than long, rounded behind. Elytra considerably broader than prothorax, parallel, narrowed and separately acuminate at apices; disc of each moderately punctured on basal two-thirds, the punctures then rather quickly decreasing and then disappearing, anteriorly the punctures largely separated by about two puncture-diameters. Ventral surfaces moderately punctured, more heavily on sides of metasternum and not distinctly on metepisternum. Legs sparsely punctured; femora broadly swollen, hind pair extending one-third their length beyond elytral apices; hind tibiae denticulate internally; first hind tarsal segment a little longer than next two combined. Length 12.2 mm.; breadth 3.3.

Female.—Antennae one-third longer than body; posterior femora not quite reaching elytral apices. Length 9.8 mm.; breadth 3.1. Paratype, length 6.3 mm.; breadth 1.8.

Holotype, male (C.M.N.H.), Hollandia, northern New Guinea, Dec. 24, 1944, Harry Hoogstraal; *allotopotype*, female (C.A.S.), same data; *paratopotype*, female (C.A.S.), Dec. 1944, L. W. Saylor; *paratopotypes*, male and female (A.M.N.H. & Lingnan) Oct.-Nov. 1933, W. Stuber; *paratype*, male (A.M.N.H.), Fly River, 8 km. below Palmer River, Papua, May 14–22, 1936, Archbold Expedition.

Differs from *T. unicolor* Pasc. in having the prothorax as broad as long, with several irregularities on disc and sides, the antennae longer and the femora larger. Dedicated to the collector of the type of this and other new species described at this time, Mr. Harry Hoogstraal.

35. **Tethionea obtusidens,** new species

Female.—Shiny reddish brown, slightly darker on basal two-thirds of

elytra; antennae reddish testaceous; legs reddish ochraceous, becoming testaceous on tarsi. Dorsal surfaces nearly glabrous; ventral surfaces with only a few scattered oblique hairs; antennae with a very few scattered oblique hairs and some very short reddish pubescence.

Head not quite as broad as prothorax, quite short, sparsely punctured; antennal supports much depressed; frons short, concave on each side; vertex nearly horizontal, shallowly grooved along middle; superior eye-lobes a little closer than inferior lobes, a slightly depressed impunctate strip along center between them; genae extremely short. Antennae barely longer than body, slender; scape arched, gradually swollen, a little longer than third segment; third and fourth subequal; fifth slightly longer; fifth and sixth equal; following slightly shorter. Prothorax about as long as broad, feebly convex at each side, constricted basally, slightly broader at apex than at base; disc finely punctured, with suggestions of some partial impunctate stripes, the punctures largely less than one-half as large as interspaces. Scutellum fully as long as broad, rounded behind. Elytra slightly dehiscent with a short obtuse tooth on each, continuous with sutural margin, disc of each with punctures mostly larger than their interspaces to beginning of distal third, there becoming sparser and disappearing just before apex. Ventral surfaces heavily punctured on sides of metasternum, feebly punctured on sides of abdomen. Legs somewhat slender, but with the femora moderately clavate; hind femora falling somewhat short of elytral apices; first hind tarsal segment as long as next two combined. Length 7 mm.; breadth 1.8. Paratype, length 8.4 mm.; breadth 2.2.

Male.—Antennae one-sixth longer than body; hind femora not reaching elytral apices. Length 6 mm.; breadth 1.65.

Holotype, female (C.A.S.), Hollandia, northern New Guinea, Apr. 16, 1945, S. G. Jewett; *allotopotype*, male (C.M.N.H.), May 1945, H. Hoogstraal; *paratype* (A.M.N.H.) Fly River, 8 km. below Palmer River, Papua, May 23–31, 1936, Archbold Exped.

Differs from *T. unicolor* Pasc. in having an obtuse tooth instead of an acuminate spine at apex of each elytron, and in having the prothorax broader anteriorly than posteriorly and without a smooth tooth near base of each side.

36. **Tethionea strumosa** Pascoe

Two (A.M.N.H.) Mt. Mabiom, July 15, and Palmer River at Black River, June 7–14, Papua, 1936, Archbold Expedition.

37. **Tethionea tenuimembris,** new species

Plate I, fig. 11

Female.—Pitchy dark reddish brown, paler reddish on head, antennae testaceous with scape ochraceous; ventral surfaces reddish ochraceous; legs testaceous, slightly ochraceous on femora. Dorsum nearly glabrous; antennae with a few oblique hairs and thin reddish pubescence; ventral surfaces and legs with only a few scattered erect or oblique hairs.

Head about as broad, and as long, as prothorax, somewhat sparsely punctured, particularly on occiput; frons short, depressed transversely at apex; vertex slightly raised horizontally, with a feeble median line;

superior eye-lobes barely closer than inferior eye-lobes; genae minute. Antennae one-sixth longer than body, very slender; irregularly punctured, a little longer than third segment; third barely longer than fourth, distinctly shorter than fifth; following gradually decreasing. Prothorax a little longer than broad, subevenly rounded at sides, with very feeble lateral swellings at middle, and between middle and apex and middle and base on each side; disc with a median postcentral raised line and a shallow depression on each side of it, finely punctured with the interspaces about as wide as the punctures. Scutellum narrowed and rounded behind. Elytra gradually slightly broadened to well behind middle, each with an acuminate tooth at apex with a suggestion of a sutural tooth and a very feeble obtuse tooth externally; disc of each moderately and sub-regularly punctured to apical quarter, the punctures mostly about as wide as interspaces. Ventral surfaces heavily punctured on sides of metasternum, medially raised and minutely punctulate on metepisterna and very sparsely punctured on sides of abdomen. Legs slender; femora gradually and moderately swollen; first hind tarsal segment as long as next two combined. Length 7.3 mm.; breadth 1.95.

Holotype, female (C.A.S.), Hollandia, New Guinea, Oct. 10, 1944, T. Aarons.

Differs from *T. unicolor* Pasc. in lacking a distinct projection on each side of prothorax, in having the scutellum longer than broad, the pronotal disc somewhat uneven, the elytra with a minute tooth on each side of apical spine and in being dark pitchy brown instead of testaceous.

38. **Tethionea tridentata** Pascoe

Several (A.M.N.H.) Palmer River at Black River, Papua, June 15–30, 1936, Archbold Expedition; Malaita, Solomon Is. (Ac. 30985); five (C.A.S. & C.M.N.H.) Hollandia, New Guinea, Nov. 21 and Dec. 2, 13, 1944, Feb. 20, 1945, H. Hoogstraal.

KEY TO THE SPECIES OF TETHIONEA

1. Elytral apices not terminated by sharp acuminate spines 2
   Elytral apices terminated by sharp acuminate spines 3
2. Elytra evenly rounded apically; prothorax distinctly broader then long; elytra with some feeble costae ..... **brevicollis** Gress.
   Elytra bluntly angulate near sutural angle of each; prothorax fully as long as broad; elytra smooth ..... **obtusidens** Gress.
3. Elytral apices each with more than one spine 4
   Elytral apices each with a single spine 5
4. Elytral apices each with two spines; prothorax with two or three tubercles on each side behind middle; elytra with dark outer borders and sometimes with an oblique postmedian band ..... **strumosa** Pasc.
   Elytral apices each with a long spine at middle and a short tooth at each side; prothorax subevenly rounded at sides; elytra without dark outer borders, rarely with an indistinct postmedian band ..... **tridentata** Pasc.
5. Prothorax longer than broad, somewhat uniformly punctured 6
   Prothorax fully as broad as long, irregularly punctured, with several low tubercles on lateral surfaces and sides of disc and a raised impunctate median line on posterior half of disc; ochraceous ..... **hoogstraali** Gress.
6. Prothorax distinctly convex at sides, fully as broad as head; prothorax with a slight projection at each side near base, or each elytral apex with a suggestion of an additional tooth on each side of median spine 7
   Prothorax feebly convex at sides, slightly narrower than head; prothorax without any lateral projections and elytral apices with only a single tooth on each 8

7. Prothorax with a slight projection at each side near base; elytral apices without a minute tooth on each side of spine; scutellum semicircular; testaceous brown..... **unicolor** Pasc.
   Prothorax without a slight projection at each side; each elytral apex with a suggestion of an additional tooth on each side of median spine; scutellum longer than broad; dark pitchy red-brown..... **tenuimembris** Gress
8. Pronotum finely punctured; abdomen impunctate; reddish yellow with sides of prothorax and elytra pitchy brown..... **apiculata** Pasc.
   Pronotum very deeply and densely punctured; abdomen slightly punctured; castaneous brown with pitchy sides and an oblique postmedian pitchy band on elytra..... **hollandiae** Gress

Tribe **Obriini**

39. **Stenhomalus figuratus** Gahan, 1915

Thirty-eight (C.M.N.H. & C.A.S.) Hollandia, northern New Guinea, Oct., 1944, to May, 1945, H. Hoogstraal.

40. **Iphrobrium constricticolle,** new species

Female.—Testaceous to pitchy red: head reddish ochraceous, antennae testaceous; prothorax reddish ochraceous, slightly pitchy red along upper portion of each side; scutellum reddish; elytra pale ochraceous, each pitchy red on basal fifth, pitchy black along lateral declivity to apical fourth, with an oblique pitchy black band across middle, directed anteriorly towards suture and another, more reddish oblique band before apex directed posteriorly towards suture, both connecting lateral stripe with suture and leaving a pale hexagon between; ventral surfaces ochraceous anteriorly, reddish on metasternum and testaceous on abdomen; legs testaceous with swollen portions of femora reddish. Body irregularly dotted with thin pubescence, silvery on thorax and goldish on elytra and abdomen.

Head as broad as elytra at bases, considerably broader than prothorax, strongly depressed, not distinctly punctured, finely grooved on vertex; eyes slightly closer behind than anterior to antennal insertions. Antennae one-fifth longer than body; scape slightly longer than second and third together, third slightly longer than fourth, fifth subequal to scape, fifth to tenth gradually shorter, eleventh barely longer than tenth. Prothorax more than twice as long as breadth at base, middle one-half again as broad as base and slightly broader than apex, basal fifth subcylindrical, sides evenly convex and apical fifth subequal; surface slightly frosted, not distinctly punctured. Scutellum small, narrow, subrounded apically. Elytra barely one-half again as long as head and prothorax combined, twice as wide at base as prothorax at base, subparallel in basal three-sevenths, evenly widened in remaining portion, and separately rounded apically; surface of each subregularly punctured in nine or ten rows on basal half, the punctures disappearing suddenly just behind middle dark band, mostly less than one puncture-width apart. Ventral surfaces not distinctly punctured. First abdominal segment nearly as long as remaining combined, second deeply emarginate and bearing a long fringe of hairs. Legs slender, tibiae hardly thicker than antennae; femora pedunculate-clavate, mid and hind pair in apical half. First hind tarsal segment equal to second and third combined. Length 5.15 mm.; breadth 0.95. Paratype, Length 4.8; breadth 1.

Holotype, female (No. 58351, U.S.N.M.), Hollandia, northern New Guinea, April 1945, B. Malkin; *paratopotype*, female (C.A.S.),

Dec. 24, 1944, H. Hoogstraal; *paratype*, female (A.M.N.H.), Sturt Island, Fly River, Papua, Oct. 14, 1936, Archbold Expedition.

Differs from **I. gynandropsidis** (Fairmaire) n. comb. in being only one-half as large and in lacking a small sutural pale spot at apex of each elytron. The elytral pattern varies. In the paratopotype it is reduced to a basal spot, central free stripe and postmedian oblique band; in the Fly River paratype the dark marks are broader, there is an almost complete sutural stripe and the marginal stripe is largely absent.

41. **Iphrobrium palauense,** new species

Male.—Slender; body pitchy brown, marked with pale testaceous to pitchy black; head reddish brown, pitchy along middle of vertex and occiput; antennae pale testaceous; prothorax pitchy black, more reddish along middle of disc and on lower side; scutellum testaceous, browner on borders; elytra pitchy brown each with base near suture, external margin to beyond middle, a discal spot near suture at end of basal quarter, and two spots placed obliquely near middle, the anterior one external and meeting pale margin, the other meeting suture, all testaceous, as well as the apex, except along suture, creamy white; ventral surfaces pitchy brown, paler towards apex of abdomen; legs testaceous with a wide pitchy band across swollen portion of each posterior femur. Body clothed with thin buff pubescence; antennae with a sparse fringe of short oblique hairs on undersides of first five segments; hind femora each with a row of stout bristles above and beneath.

Head nearly as long as prothorax, minutely granulose-punctate; eyes about as widely separated as antennal insertions both above and below latter. Antennae barely longer than body; scape one-fourth longer than third segment; third one-half again as long as fourth; fourth barely over one-half as long as fifth; sixth and following decreasing in length. Prothorax much narrower than head, nearly twice as long as broad, apex slightly narrower than middle and wider than base; disc finely and densely granulose-punctate. Scutellum narrow, subtriangular. Elytra nearly two-fifths again as long as head and prothorax combined, slightly broadened behind middle, distinctly punctured in rows to middle. Length 4.6 mm.; breadth at humerus 0.7.

Holotype, male (C.A.S.), Peleliu Island, Palau group, July 28, 1945, E. Hagen; *allotopotype*, female (C.A.S.), July 29; *paratype*, female (C.A.S.), Garakayo I., Palau group, Aug. 8, 1945, E. Hagen.

The allotopotype is much paler than the holotype and the paratype is somewhat paler. Both the allotype and the paratype have the apical spot the same color as the rest of the elytral spots and they have two additional spots on each elytron between the middle and the apex. Length 5–6 mm.

Differs from *I. guamense* Gress. in being smaller, in having the fourth antennal segment shorter, the head and pronotum not smooth, heavily punctured, the elytra less parallel and the coloration darker.

42. **Iphrobrium spinipenne,** new species

Plate I, fig. 3

Female.—Largely reddish, in part testaceous to pitchy black: head reddish castaneous; antennae testaceous, slightly ochraceous on scape; prothorax shiny pale reddish castaneous, partly transparent, with a

broad straight longitudinal black stripe on each side of upper portion and base blackish; scutellum pitchy; elytra pitchy with a large common premedian oblong and somewhat smaller postmedian roundish area and apices, obliquely, pale ochraceous; ventral surfaces pitchy red on thorax and testaceous on abdomen; legs testaceous with femoral clubs reddish to pitchy. Body largely clothed with very thin satiny silvery buff pubescence, lacking on occiput, discal and anterior portions of pronotum and anterior majority of prosternum; antennae with oblique stiff hairs on inner sides of first five or six segments, with specially long ones at ends of third and fourth; head, pronotum, elytra, abdomen and legs with sparse suberect hairs.

Head as broad as elytral bases, much broader than prothorax; frons minutely roughened, medially grooved onto occiput between upper eye-lobes; a few scattered punctures near inner borders of upper eye-lobes. Antennae slender, one-fourth longer than body; scape swollen a little beyond middle, distinctly longer than second and third segments combined; fourth three-fourths as long as third; fifth practically as long as third and fourth combined; sixth about as long as scape; following shorter. Prothorax nearly twice as long as breadths at apex; middle as broad as apex, with a feeble constriction in between; base four-fifths as broad as apex; disc smooth, with only a few widely scattered punctures, Scutellum narrow, rounded behind. Elytra not quite one-half again as long as head and prothorax combined, distinctly widened behind middle, separately acuminate apically; disc of each with eight subregular rows of distinct punctures on basal three-fifths, the rows separated on disc by about twice a puncture-diameter. Ventral surfaces not distinctly punctured. Hind femora not reaching elytral apices, gradually swollen for distal halves; first hind tarsal segment as long as next two segments combined. Length 7.3 mm.; breadth 1.45.

Holotype, female (C.A.S.), Maffin Bay, northern New Guinea, Oct. 6, 1944, Dr. E. S. Ross.

Similar to **I. carabiformis** (McKeown) n. comb. but with the elytra sharply spined apically. Differs from *I. gynandropsidis* (Fairm.) in being smaller and in having the elytra spined apically and with the apices obliquely pale.

McKeown's genus *Nerida* (Rec. Austral. Mus. 20: 293, 1940) is a synonym of *Iphrobrium* Gressitt (Ins. Mats. 9: 150, 1935), and the two species named by McKeown are included in the following key. McKeown placed his genus in the Callidiopini, and did not mention the structure of the abdomen, which is typical of the Obriini, with the first segment longer than the rest combined, at least in the female.

KEY TO THE SPECIES OF IPHROBRIUM

1. Pronotum rather smooth, lacking two small tubercles anterior to middle.... 2
   Pronotum bearing two small tubercles anterior to middle; prothorax distinctly broader anterior to middle than at apex; length 8 mm.; Queensland.....**intricata** (McK.)
2. Posterior portion of each elytron separated from anterior punctured portion by an oblique brown line..... 3
   Posterior portion of each elytron not separated from anterior portion by an oblique line..... 6
3. Elytra spined or obtusely toothed apically; third and fourth antennal segments each with a long apical bristle..... 4
   Elytra conjointly rounded apically..... 5

4. Elytra each obtusely toothed apically; prothorax convex at middle of each side; hind femora narrowly banded with dark at middle; length 9 mm.; Queensland ..... **carabiformis** (McK.)
   Elytra each with an apical spine; prothorax subcylindrical at middle; hind femora with clubs entirely dark; length 7.3 mm.; New Guinea, **spinipenne** Gress.
5. Each elytron with a small apical pale spot near suture; length 9 mm.; Tahiti; Samoa ..... **gynandropsidis** (Fairm.)
   Each elytron lacking a small apical pale spot near suture; length 4.8–5.15 mm.; New Guinea ..... **constricticolle** Gress.
6. Fourth antennal segment more than one-half as long as fifth 7
   Fourth antennal segment approximately one-half as long as fifth 8
7. Head and pronotum finely and densely granulose-punctate, prothorax distinctly broader at apex than at base; elytra strongly widened posteriorly; length 4 mm.; Ryukyu Is. (type) ..... **dilatipenne** Gress.
   Head and pronotum almost impunctate; smooth and shiny; prothorax barely broader at apex than at base; elytra subparallel-sided; length 7 mm.; Guam ..... **guamense** Gress.
8. Elytral apices broadly pale; each elytral disc with two to six rounded or irregular spots; head punctured; length 4.6–6 mm 9
   Elytral apices narrowly pale; each elytral disc with two oblong pale spots; head almost impunctate; length 8 mm.; Fiji Is. ..... **oblongoguttulum** (Fairm.)
9. Elytral apices broadly pale except at suture; each elytral disc with at least three spots, generally five or six, besides most of the external margin pale; elytra punctured to middle; head densely punctulate; length 4.6–6 mm.; Palau Is ..... **palauense** Gress.
   Elytral apices transversely pale; each elytral disc with two pale spots, placed obliquely at middle, external margin not pale; elytra punctured to apical quarter; length 5.5 mm.; N. Borneo ..... **quadriguttata** (Heller)

43. **Iphra euderceoides,** new species

Plate I, fig. 7

Female.—Purplish black to pale pitchy: head black, pitchy anteriorly; antennae pitchy brown, with second to fourth segments, and basal halves of fifth to eighth, ochraceous; prothorax black with a slight metallic tinge; elytra slightly purplish black, pitchy reddish apically, each with two oblique dark silvery gray bands, one before and one behind middle, the first complete and the second disappearing at top of lateral declivity, together forming a trapezoid with the broad side external and the area covered with velvety black pubescence as is sutural portion of basal area; ventral surfaces pitchy reddish black; legs pitchy with tarsi, bases of femora and apices of tibiae reddish. Ventral surfaces with only a little pubescence; tibiae with a few long oblique hairs.

Head as broad as prothorax, oblique anteriorly; frons broader than deep, with shallow longitudinal punctures anteriorly and irregular longitudinal ridges and grooves posteriorly; vertex horizontal; eyes large; genae minute. Antennae slightly longer than body, rather slender, except for scape and the thickened distal portions of apical segments; scape slightly longer than third segment, thickest somewhat before apex; fourth two-thirds as long as third; fifth longer than third and nearly as long as scape; sixth and following shorter. Prothorax longer than broad, slightly wider at middle than at apex, only slightly more than one-half as wide at base as at middle; disc covered with long, partly branching raised longitudinal lines. Scutellum much longer than broad, parallel-sided. Elytra one-half again as long as head and prothorax combined, slightly constricted just anterior to middle, broadened

posteriorly and conjointly rounded apically; disc of each with anterior third irregularly and partly lineate-punctate, central velvety area rather closely punctured and apical area impunctate. Ventral surfaces partly shagreened, not distinctly punctured. Legs with hind femora slightly exceeding elytral apices, suddenly clavate for apical halves; first hind tarsal segment about as long as next two combined. Length 3.9 mm.; breadth 1.2.

Holotype, female (C.M.N.H.), Hollandia, northern New Guinea, Dec. 24, 1944, Harry Hoogstraal.

Differs from *I. tillomorphoides* Pascoe in being smaller, in having the elytra relatively longer and with the anterior pale band unbroken, the second band incomplete externally and dividing the closely punctured central portion from the impunctate apical portion, the antennae and legs partly pale and the prothorax with raised lines partially extending for its entire length, and partly branching.

The genus *Obriomorpha* Aurivillius (Arkiv f. Zool. (10) 23: 20; type: *triangulifera*, l.c.: 21, pl. 2, fig. 9, 1917) should apparently be synonymized with *Iphra* Pascoe, 1869. Aurivillius mistakenly placed *Obriomorpha* in the Tillomorphini. McKeown's genus *Wahn* (Rec. Austral. Mus. 20: 295; type: *zonulitis*, l.c., pl. 32, fig. 5, 1940) is probably also a synonym of *Iphra*. McKeown placed *Wahn* in the Callidiopini.

KEY TO THE SPECIES OF IPHRA

1. Pronotum and occiput with distinct fine longitudinal ridges; prothorax very little longer than broad 2
   Pronotum impunctate or densely punctured, at most with obsolete striations; prothorax distinctly longer than broad 3
2. Pronotum with ridges partly extending for entire length, partly branching; antennae and legs partly pale; length 3.8 mm.; New Guinea, **euderceoides** Gress.
   Pronotum with many short separate ridges; antennae and legs black to slightly pitchy; length 6 mm.; Ceram (type) ..... **tillomorphoides** Pasc.
3. Pronotum densely punctured, with obsolete striations; black, elytra with a subbasal triangular area and postmedian band of whitish pubescence; femora exceeding elytral apices; length 8 mm.; Queensland .. **triangulifera** (Aur.)
   Pronotum impunctate; largely red with femora and posterior halves of elytra black, red and black parts of elytra separated by a narrow curved white band; femora not reaching elytral apices; length 4–5 mm.; New South Wales ..... **zonulitis** (McK.)

Tribe **Uracanthini**

44. **Uracanthus daviumbus,** new species

Male.—Reddish brown, in part somewhat pitchy; head reddish; antennae dull brown except for reddish scape; prothorax pitchy brown, more reddish beneath and on apical and basal borders; scutellum pitchy; elytra reddish, somewhat pitchy a short distance behind humeri; ventral surfaces dark reddish brown, paler on abdomen; legs dark brown, paler on tarsi and fore legs. Body extensively clothed with tawny buff pubescence: head moderately clothed above and on genae; antennae thinly and briefly clothed; prothorax not very densely clothed above, with a partial glabrous median line and a subglabrous lateral line above the denser and paler pubescence of under side; scutellum and elytra somewhat densely and regularly clothed except for a short humeral

stripe on each elytron; ventral surfaces rather densely and evenly clothed, a little thinner on abdomen; legs moderately clothed.

Head nearly as broad as prothorax, finely punctured; median groove complete from neck to branches on each side of triangular clypeus; frons short, constricted both transversely and longitudinally; vertex subacutely concave; eyes large, nearly meeting above; genae about one-sixth as deep as eyes. Antennae one-sixth longer than body, flattened; scape stout, slightly arched, finely punctured, four-fifths as long as third segment; fourth and fifth successively a little longer; fifth and sixth subequal; following successively slightly shorter. Prothorax a little longer than broad, gradually narrowed from base to apex except for a broad low tubercle at middle of each side; disc with about 16 smooth transverse corrugations, part of which are incomplete or anastomosing. Scutellum rounded trapezoidal. Elytra gradually narrowed to middle, parallel-sided posteriorly; apex of each briefly emarginate-truncate and strongly acuminate at sutural angle; disc finely and irregularly punctured. Ventral surfaces closely and minutely punctured. Femora broad, hind pair less than one-half as long as abdomen; first hind tarsal segment not quite as long as next two combined. Length 15 mm.; breadth 2.45. Paratype, length 11.4.

Female.—Antennae five-sixths as long as body; elytra broader and more parallel-sided, feebly emarginate apically without any spines; hind femora not reaching end of second abdominal segment. Length 16 mm.; breadth 2.85.

Holotype, male (A.M.N.H.), Lake Daviumbu, Fly River, Papua, New Guinea, Aug. 19–30, 1936, Archbold Expedition; *allotopotype*, female (A.M.N.H.) and two paratopotypes, males (C.A.S. & Lingnan), same data.

Differs from *U. dentiapicalis* McKeown in having the eyltral apices very briefly emarginate-truncate, with only sutural angles toothed, the pronotum completely corrugated and the elytral discs without median ridges.

45. **Uracanthus declivis,** new species

Plate I, fig. 6

Female.—Dark pitchy reddish brown, nearly black on prothorax, paler reddish on anterior femora. Body irregularly clothed with tawny pubescence, a little more ochraeous on prothorax; head moderately clothed above except on clypeus and behind post-ocular constriction, thinner along middle of each half of frons; genae and undersides nearly glabrous; antennae thinly and briefly clothed; prothorax subglabrous above except for a dense straight stripe along each side of upper portion and another less straight one on lower part of each side, more or less merging with complete, paler pubescence of under surface; scutellum nearly glabrous; elytra almost entirely covered with indistinct, partly merging longitudinal streaks of pubescence except on, and immediately behind, humeri and just before the fringed apices; ventral surfaces largely clothed, but more densely so at sides; legs moderately clothed.

Head slightly broader than prothorax, a little narrower than elytra, finely punctured, strongly grooved medially to postocular constriction, the groove dividing anteriorly to set off the equilaterally triangular

clypeus; frons slightly constricted; vertex obtusely concave between antennal insertions; eyes large; genae about one-third as deep as eyes. Antennae about as long as body, flattened; third to tenth segments bluntly toothed ectoapically; scape a little shorter than third segment; third to fifth successively slightly longer; sixth to tenth successively slightly shorter; eleventh narrowed a short distance from apex. Prothorax a little longer than broad, gradually narrowed from base to apex except for a feeble rounded tubercle at middle of each side; disc shallowly, and in part incompletely, corrugated transversely. Scutellum rounded trapeziform. Elytra each narrowed to behind middle; then slightly broadened, and broadly rounded apically, finely and irregularly punctured, becoming obliquely declivitous posteriorly, forming a right angle at suture. Ventral surfaces minutely punctured. Hind femora about one-half as long as abdomen, gradually swollen; first hind tarsal segment barely as long as next two combined. Length 15 mm.; breadth 2.55.

Holotype, female (Taiwan Agric. Res. Inst.), Wareng, on mainland opposite Amberpon (Roemberpon) I., western side of Geelvink Bay, N.W. New Guinea, Aug. 1936, Prof. S. Issiki.

Differs from *U. **multilineatus*** McKeown in being narrower at the humeri, in having the elytra separately and broadly rounded and distinctly fringed apically and the pronotum grossly corrugated transversely.

Tribe **Calliprasonini** (Stenoderini)

46. **Syllitus bicolor** (Schwarzer), 1924, new combination

Male.—Black with a brownish tinge; head and prothorax red; antennae slightly pitchy distally; scutellum pitchy; tarsi and bases of tibiae slightly brownish. Antennae with short erect fine silvery hairs on undersides of first seven segments.

Head broader at genae than at neck, barely broader at genal angles than at anterior borders of eyes, finely and sparsely punctured; frons more heavily and densely punctured; genae impunctate, three-fourths as long as eyes. Antennae as long as body; scape slightly arched, gradually thickened, as long as next three segments combined; third and following subequal. Prothorax a little longer than broad, nearly as broad as head, strongly swollen at sides just behind middle, deeply constricted one-third from apex, and swollen between constriction and apex; disc with four feeble rounded swellings forming a trapeze with shorter end anteriorly, with a small longitudinal swelling inside trapeze; surfaces partly finely punctured, mostly on basal half. Scutellum oblong, concave in center. Elytra each briefly spined apically; disc of each with four strong ridges, each free at apex and second from suture longest; puncture-rows between ridges from suture to external margin approximately 2 : 4 : 2 : 2 : 2 at middle. Hind femora reaching to end of third abdominal segment; first hind tarsal segment a little shorter than next two combined. Length 10.2 mm.; breadth 1.75.

Female.—Antennae almost as long as body, finely fringed beneath on third to sixth segments; elytral apices acute but hardly spined; posterior femora reaching to beyond middle of third abdominal segment. Length 9.1 mm.; breadth 1.65.

Both sexes (A.M.N.H. & C.A.S.) Fly River, 8 km. below Palmer River, Papua, May 14–31, 1936, Archbold Expedition; female (A.M. N.H.) Wasian, W. New Guinea, Sept. 20, 1939, R. G. Wynd.

This species was briefly described as *Hoplosyllitus bicolor*, but the genus *Hoplosyllitus* has apparently not been described, and is apparently not distinct from *Syllitus*.

47. **Syllitus papuanus** Gestro, 1875

One (A.M.N.H.) Lake Daviumbu, Fly River, Papua, Aug. 19–30, 1936, Archbold Exped. *S. sinuatus* McKeown is at least very closely related to this species.

48. **Syllitus sexlineatus,** new species

Plate I, fig. 10

Female.—Pitchy reddish black; ochraceous on anterior portion of head and on vertex, reddish on underside of head and anterior end of sides and venter of prothorax; antennal scape nearly black except at base; elytra each with nearly all of first discal costa, two-thirds of second costa and nearly all of external margin, whitish testaceous. Ventral surfaces, antennae and legs with very sparse fine pale recumbent pubeccence, antennae unfringed beneath.

Head a little longer than broad, broader than prothorax, finely and sparsely punctured; frons broader anteriorly, depressed and impunctate medially; vertex rounded-concave; genae about two-thirds as long as eyes. Antennae (last three segments missing) nearly as long as body; scape feebly arched, gradually thickened, longer than next three segments combined; third and following segments subequal. Prothorax a little longer than broad, strongly swollen at each side just behind middle, constricted anterior to middle and swollen again just before apex; disc with four rounded swellings on basal two-thirds and a longitudinal raised line between them; surfaces distinctly punctured, more densely and finely so on lower parts of sides, on posterior discal swellings and along a longitudinal groove on each outer side of discal swellings. Scutellum a little longer than broad, oblong, depressed behind center. Elytra slightly broadened posteriorly, separately bluntly angulate apically; disc of each with four ridges ending free, the second and third longest; puncture-rows between ridges from suture to external margin 3 : 4 : 2 : 2 : 2 at middle, first interspace with two puncture-rows anteroorly. Ventral surfaces and legs minutely and closely punctulate; hind femora reaching to middle of third abdominal segment; first hind tarsal segment shorter than next two combined. Length 7.85 mm.; breadth 1.5. Paratypes, length 9 mm.; breadth 1.75.

Male.—Similar to female but with antennal segments III through VI finely fringed on undersides, sixth segment only partially so; antennae as long as body. Length 8.9 mm.; breadth 1.5 mm.

Holotype, female (C.M.N.H.) Hollandia, northern New Guinea, Dec. 24, 1944, Harry Hoogstraal; *allotopotype* male (C.A.S.) Dec. 13, 1944; *paratopotypes* (C.M.N.H. and C.A.S.) female, Nov. 22, 1944, males Dec. 24, 1944 and Dec. 13, 1944, female, Feb. 20; *paratype*, female, Koitaki, alt. 500 met., New Guinea, Nov.-Dec. 1928, C. E. Pemberton (H.S.P.A.).

Differs from *S. rectus* (Newm.) in being less elongate, in being largely black, with the second elytral ridge pale for only two-thirds its length and the prothorax more constricted anterior to middle and more swollen again near apex.

49. **Syllitus undulatus** Heller, 1914

Several (A.M.N.H.) Fly River, 8 km. below Palmer River, Papua, May, and Oroville, Upper Fly River, Aug., 1936, Archbold Exped.; Hollandia, New Guinea, Jan. & Dec., 1933, W. Stuber; (C.A.S.) Hollandia, Nov., 1944, Hoogstraal; (Taiwan Agr. Res. Inst.) Windesi—Majosi, W. Geelvink Bay, N. W. New Guinea, Jul.-Aug. 1936, S. Issiki.

KEY TO THE NEW GUINEA SPECIES OF SYLLITUS

1. Elytra spined, toothed or angulate apically 2
   Elytra evenly rounded apically, without suggestion of angles, teeth or spines; ochraceous with partly testaceous elytral ridges; pronotum dusky along middle ..... **papuanus** Gestro
2. Elytral apices toothed or merely angulate; body largely black 3
   Elytral apices strongly spined; body largely ochraceous, elytra testaceous, each with a sinuous brown stripe starting on humerus, curving to suture, then to external margin and to apex, inner two ridges entirely pale ..... **undulatus** Heller
3. Elytra toothed or briefly spined apically; head and prothorax reddish ochraceous; elytra and legs entirely blackish ..... **bicolor** (Schw.)
   Elytra simply angulate apically; body almost entirely black; first and second ridges and external margin of each elytron whitish ..... **sexlineatus** Gress.

Tribe **Molorchini**

50. **Epania cobaltina,** new species

Female.—Deep steely blue, metallic, in part with greenish tinges: head slightly greenish; antennae opaque black, metallic and slightly purplish on scape; prothorax slightly greenish blue, clothed with silvery pubescence at each side of anterior and posterior constricted portions; scutellum silvery pubescent; elytra cobalt blue; ventral surfaces deep blue; abdomen tinged with greenish, second segment with silvery pubescence at sides; fore and middle legs pitchy red-brown with a purplish tinge; hind legs bluish-black with a pitchy tinge, redder on tarsi, bases of femora and apices of tibiae. Body largely clothed with erect pale brownish to silvery hairs, much shorter on elytra, with some distinctly paler hairs along suture just behind scutellum.

Head not quite as broad as prothorax, closely and rather deeply punctured, a sinuate inter-punctural strip on each side of frons; frons flat, constricted by eyes; vertex very feebly concave; occiput slightly raised medially; genae about one-fifth as deep as eyes. Antennae reaching to beyond middle of abdomen; fourth and following segments stouter than first three; scape shiny and with some deep punctures, barely longer than third segment; pedicel as broad as long; fourth and following subequal, each a little longer than third. Prothorax a little longer than broad, broadest just behind middle, strongly and rather suddenly constricted near base, gradually and slightly narrowed towards apex, somewhat constricted above a short distance from apex; disc very grossly punctured, the punctures extremely close, often almost over-

lapping, apical and basal constricted portions largely impunctate. Scutellum as broad as long, broadly rounded posteriorly. Elytra not quite reaching to anterior borders of hind coxae, each narrowed and unevenly rounded apically, about one-half again as long as broad; disc asperate-punctate, with most of asperations smaller than interspaces, an oblique raised area on inner portion, separated from external portion and apex by an obliquely longitudinal depression, distal portion raised and more strongly asperate. Ventral surfaces sparsely punctured. Legs more closely punctured, with tibiae and hind femora somewhat asperate; hind femora reaching to apex of abdomen; hind tibiae slightly arched; first hind tarsal segment barely longer than next two segments combined. Length 8 mm.; breadth 2.2.

Holotype, female (A.M.N.H.), New Guinea (no other data); *paratype*, female (C.A.S.) same data.

Differs from *E. opaca* Fisher in being metallic blue to greenish instead of opaque black, in having the frons narrower, the fourth antennal segment very little longer than scape, the prothorax longer than broad, and strongly constricted basally, etc.

51. **Epania rufipes**, new species

Plate I, fig. 8

Female.—Metallic steely blue tinged with purple or lavender, legs largely red; head steel blue; antennae bluish black, somewhat pitchy purplish on scape; prothorax dark blue with a lavender tinge; scutellum blackish with silvery pubescence distally; elytra steel blue with a lavender tinge; ventral surfaces metallic blue, tinged with pitchy red to purplish, particularly on mesothorax and abdomen, some silvery pubescence on meso- and metasterna and coxae; legs reddish ochraceous, pitchy purplish on tarsi, hind tibiae, outer or distal portions of fore and middle tibiae and bases of femora. Body thinly clothed with moderately long erect hairs, darker above, longer and paler beneath, extremely short on elytra.

Head not quite as broad as prothorax, rather closely and heavily punctured; frons slightly raised, flat, somewhat constricted by eyes, obtuse anteriorly and more heavily punctured than clypeus; vertex distinctly concave between antennal insertions; occiput feebly raised along median line at center, more finely punctured posteriorly; genae about one-sixth as deep as eyes. Antennae four-fifths as long as body, somewhat flattened distally with fifth to tenth segments briefly angulate ectoapically; third segment slightly longer than scape and a little shorter than fourth; fourth to sixth subequal; sixth to tenth decreasing slightly in length. Prothorax a little longer than broad, broadly and somewhat evenly rounded at sides, widest just before middle, strongly and suddenly constricted near base and slightly constricted near apex, constricted portions shallowly or partially punctured; disc grossly and very closely punctured, the punctures slightly smaller near center. Scutellum broader than long, rounded trapeziform. Elytra reaching nearly to middle of hind coxae, dehiscent from bases; each narrowed and obtusely rounded apically with disc rather closely asperate-punctate on inner part of raised inner portion, and along middle from humerus to apex, exterior to oblique depression, more sparsely and more normally punc-

tured on remainder. Ventral surfaces rather sparsely, shallowly and irregularly punctured. Legs with femora strongly swollen; pedunculate-clavate, the hind pair not quite reaching apex of abdomen; hind tibiae stout, slightly arched and asperate; first hind tarsal segment about as long as next two combined. Length 9.5 mm.; breadth 2.65.

Male.—Antennae nearly one-half again as long as body; hind femora reaching apex of abdomen.

Holotype, female (No. 58352, U.S.N.M.), Bougainville Island, Solomon Islands, 1944; ***allotopotype***, male (C.A.S.), June 5, 1944; both taken by Dr. A. B. Gurney.

Similar in structure to the preceding, but larger, differently colored, with less silvery pubescence and with the hind femora more suddenly clavate. Differs from *E. **pusio*** Pascoe in being largely metallic, in having the antennae dark and the femora reddish, the elytra asperate-punctate, etc.

KEY TO THE SPECIES OF EPANIA FROM THE MALAY ARCHIPELAGO AND SOUTHWESTERN PACIFIC

1. Posterior femora gradually clavate 2
   Posterior femora abruptly clavate 6
2. Elytra at least partly yellowish, not entirely metallic; antennae and legs often largely yellow or brownish; pronotum banded with pubescence anteriorly 3
   Elytra entirely metallic deep blue; antennae and legs bluish black; pronotum not banded with pale; New Guinea ..... **cobaltina** Gress.
3. Elytra yellowish with apices, and sometimes outer margins, brownish, blackish or bluish 4
   Elytra black with center yellowish, or yellowish with marginal stripes and oblique discal stripe brown or black 5
4. Elytra reddish yellow with outer margins and apices bordered with dark brown or black; legs black; Borneo; Moluccas ..... **sarawackensis** (Th.)
   Elytra yellowish brown, tinged with bluish at apices; legs yellow to blackish, with fore and middle femora shiny yellow; Ceram ..... **discolor** Pasc.
5. Elytra black with centers yellowish; antennae dark reddish brown with scape black; third, fourth and fifth abdominal segments with white pubescence at sides; Borneo ..... **paulla** Pasc.
   Elytra yellowish with marginal stripes and oblique discal stripe brown or black; antennae black; second and fourth abdominal segments with white pubescence at sides; N. Borneo ..... **petra** Heller
6. Elytra purplish brown or black, or greenish black with orange apices 7
   Elytra metallic steely blue 9
7. Elytra purplish brown or black, not pale apically 8
   Elytra greenish black with orange apices; antennae brown with first two segments reddish brown; legs dull with dense black hairs; Sumatra, **fulvonotata** (Nonfr.)
8. Elytra purplish brown; antennae brown; head and prothorax reddish brown; femora pale pitchy; Singapore ..... **pusio** Pasc.
   Elytra black; antennae dark brown distally; remainder of body black; Java ..... **opaca** Fisher
9. Legs partly or largely pitchy brown or bluish 10
   Legs largely bright reddish; antennae bluish black, somewhat pitchy purplish on scape; Solomon Is. ..... **rufipes** Gress.
10. Antennae brownish with first two segments red; femora bluish, hind pair with a broad testaceous ring on peduncle; Singapore; Borneo, **singaporensis** (Th.)
    Antennae entirely brown; fore and middle femora pitchy brown; hind femora bluish; Singapore; Borneo ..... **brevipennis** Pasc.

NOTES ON THE SIMULIIDAE (DIPTERA) OF GUATEMALA, INCLUDING DESCRIPTIONS OF THREE NEW SPECIES[1]

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This paper represents the fourth in a series of papers (2,3,4) on the Simuliidae of Guatemala. It contains descriptions of three new species, information concerning their ecology and distribution, additions to and corrections of descriptions of species recently made by the author, and taxonomic and distributional notes on various species found in Guatemala.

Simulium (Dyarella) acatenangoensis, new species

Male.—3.4 mm. long.

Head: Holoptic. Eyes dark reddish-brown. Antennae 11-segmented, only slightly tapering; basal two segments reddish-yellow, the others dark brown. Palpi reddish-brown at base, black along the remainder of their length. Clypeal region white-pruinose.

Thorax: Mesonotum velvety-black; when viewed from above, with the head directed forward and downward, and with the light source from in front at a 45° angle to the specimen, there is seen on either side of the midline a longitudinal band of white pruinosity which begins a very short distance behind the anterior margin of the notum and extends two-thirds of its length; the posterior ends of the two bands blend into a posterior patch of the same color, thus forming a white "U"; humeral angles white-pruinose; perimeter of mesonotum with numerous, golden-yellow, appressed scales, longer and broader than the scales on the female; on some specimens these scales are found on entire anterior half of notum. Scutellum reddish-brown, with golden-yellow scales on both sides, the scales being so numerous that the entire structure appears golden; several long, slender, erect, black hairs also present. Postnotum yellowish-brown, with triangular patch of greyish pruinosity on either side of the midline, contiguous with the anterior margin; devoid of hairs. Pleura evenly grey-pruinose. Halteres with brown stem and yellow knob. Wings, 3.5 mm. long; Sc pilose along basal third; R_1 pilose along slightly more than its distal half; R_{2+3} simple, pilose except for small basal region which is bare; Cu_2 arcuate; discal cell absent.

[1]The studies and observations on which this article is based were conducted with the support of the Laboratory of Tropical Diseases of the National Institutes of Health, U. S. Public Health Service, under the sponsorship of the Pan American Sanitary Bureau in cooperation with the Dirección General de Sanidad Pública of the Republic of Guatemala. The investigation was aided by a research grant from the Division of Research Grants and Fellowships of the National Institutes of Health. Costs of publication are paid by the Pan American Sanitary Bureau.

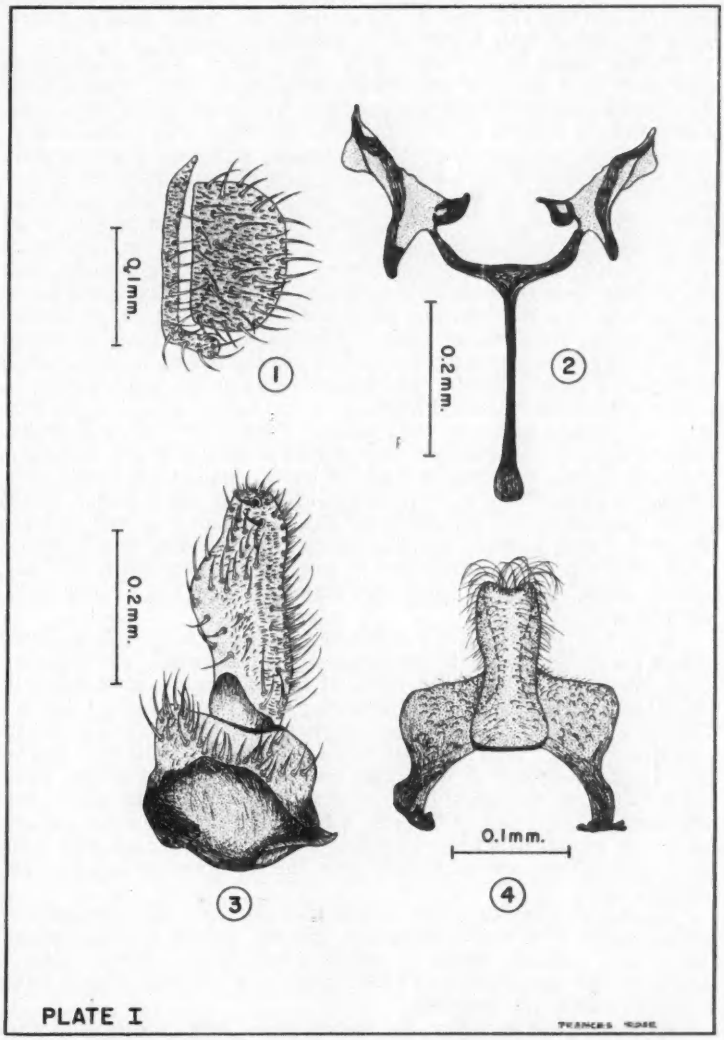
Legs: Leg 1—Length, 3.6 mm.; coxa and trochanter yellow; femur yellow, with very small dark patch apically on dorsal and ventral sides; tibia with small basal yellow ring, followed by black ring, then a central dark brown region, and finally a terminal black ring; tarsus completely black. Leg 2—Length, 3.1 mm.; coxa dark brown, trochanter yellow; femur yellow with apical dark brown ring; tibia same as for leg 1; tarsus with all segments black except the basal half of basitarsus and a very minute basal section of second tarsal segment, which are yellow. Leg 3—Length, 3.7 mm.; coxa and trochanter with same coloration as on leg 2; femur yellowish-brown with dark brown apical ring; tibia broad, dark brown except for very small yellow basal section and a black ring adjacent to it; tarsus with same color pattern as on leg 2; calcipala and pedisulcus well-developed.

Abdomen: Tergite of first segment dark brown, the pleurites black and completely clothed with very long, tan-colored hairs; second segment yellowish-brown, the tergite covered with white pruinosity; all other tergites velvety-black with median patch of grey pruinosity, and clothed with short black hairs, evenly distributed over the surface; segment seven with grey pruinosity along anterior margin of the pleurites. Sternites brown with central longitudinal black band.

Genitalia: Side-piece (Fig. 3) almost square, very slightly wider than long; dorsal opening large, quadrangular, with its angles directed toward each of the margins of the side-piece. Clasper (Fig. 3) much longer than wide, with large bulge on inner margin; well marked opening on interior face at base; apex of clasper somewhat truncate; two apical spines, one more terminal than the other, arise along an oblique line, apparently formed by a large concentration of short spine-like hairs. Body of adminiculum (Fig. 4) much wider than long, the basal prolongations wide, hyaline, ending in a flat, spatulate plate with finger-like extensions; ventral surface of body of adminiculum clothed with short hairs, more numerous toward the posterior margin; central region of adminiculum inflated, more so on the ventral surface than on the dorsal, to form a tube-like structure which extends posteriorly beyond the apical margin of the body of the adminiculum; the extension being longer than the body of the adminiculum itself; in cross-section this tube is approximately oval at its base and apex, but toward its mid-region it is constricted near the dorsal surface, thereby giving it an hour-glass appearance; tube with apical indentation from which extend rather long, curled hairs; similar hairs present along lateral margins; very short hairs completely clothe the ventral surface of tube and also the apical part of the dorsal surface. Adminicular arms (Fig. 5) with teeth along distal half, the apex with the teeth so grouped as to form a dome; the lateral plate subquadrangular, wrinkled.

Female.—3.7 mm. long.

Head: Dichoptic. Antennae 6.3 mm. long, 11-segmented, only slightly tapering, all segments subequal in length; basal two segments yellow, the others dark brown. Palpi orange-brown at base, the remainder dark brown. Eyes dark brown to black. Fronto-ocular triangle 154μ high, 67μ at base. Frons, clypeus, fronto-ocular triangle, and occipital region reddish-brown, completely invested with greyish-white pruinosity, clypeal hairs short, silvery; hairs of frons and occipital



Simulium (Dyarella) acatenangoensis, n. sp. FIG. 1. Cercus and anal lobe of female. FIG. 2. Genital rod of female. FIG. 3. Side-piece and clasper of male (dorsal view). FIG. 4. Adminiculum of male (ventral view).

region black. Bucco-pharyngeal apparatus (Fig. 6) with cornua greatly expanded and heavily sclerotized, the dorsal margin serrate along its entire length; border of median space hyaline.

Thorax: Mesonotum clear, dark, rust-brown, with short black appressed hairs sparsely distributed throughout; when viewed from above, with the head directed forward and downward, and with the light source from in front at a 45° angle to the specimen, two wedge-shaped, white-pruinose patches are visible, contiguous with the anterior margin, one on either side of the midline; the posteriorly directed angle of each patch is elongated to form a longitudinal band, also white-pruinose, which extends three-fourths the length of the mesonotum to just before the prescutellar depression, there uniting with the grey-pruinose patch which clothes the posterior fourth of the mesonotum; extending along the midline, from the anterior margin also to the posterior fourth of the mesonotum, is a very narrow, white-pruinose line; narrow, appressed, silvery-white scales rather evently distributed on anterior fourth of notum and on its lateral margins; small transverse region, immediately posterior to anterior fourth, with golden-yellow scales, shorter than the silvery-white ones; posterior fourth with few silvery scales, longer than those on other parts of the notum. Postnotum yellowish-brown, covered with silvery pruinosity, and devoid of hairs or scales. Scutellum yellowish-brown, with numerous silvery scales, similar to those on posterior part of mesonotum, and with several long, fine, black hairs. Pleura evenly grey-pruinose. Halteres with tan stem and pale yellow knob. Wings, 3.7 mm. long; Sc pilose along basal three-fifths, usually with a single hair near apical extremity; R_1 pilose only along distal half; R_{2+3} simple, pilose except for small bare region at base; Cu_2 arcuate discal cell absent.

Legs: Leg 1—Length, 3.9 mm.; coxa and trochanter yellow; femur yellow except for minute brown patch on ventral surface near the apex; tibia pale yellow on basal two-thirds of ventral face, the same region on dorsal face black; apical third completely black; tarsus black. Leg 2—Length, 3.4 mm.; coxa dark brown, trochanter yellow; femur yellow with apical dark ring; tibia with apical half black, the basal half divided into basal two-thirds of basitarsus and basal fourth of second tarsal segment yellow, the apical parts of these segments, and all other tarsal segments, black. Leg 3—Length, 4.1 mm.; with same color patterns as on leg 2; calcipala and pedisulcus well-developed; claw with basal heel extended to form secondary spur, but with no sub-basal or sub-median teeth.

Abdomen: Tergites of first and second segments white-pruinose, all others black with black pruinosity; pleural regions of first segment black with posterior fringe of yellow hairs; second through seventh segment with tan-pruinose pleurae; eighth segment with pleurae black. Sternites evenly tan-pruinose.

Genitalia: Cercus (Fig. 1) higher than long, posterior margin rounded, clothed with many strong hairs and numerous minute, spine-like hairs. Anal lobe ribbon-like, with ventral extremity curved around border of cercus and with a similar investiture of hairs as on cercus. Genital rod (Fig. 2) with short basal dilatation, triangular in shape; apical expansions triangular with interior basal angle hyaline, but with a

secondary hollow, conical, heavily sclerotized spur extending from it at an angle, with external basal angle pronounced but with apex blunted, and with the apical angle heavily sclerotized and rather sharply pointed; hyaline, wing-like expansions on outer margin of each of the two triangles near its apex; union of two branches of genital fork forming a greatly elongated triangle. Ovipositor well developed, ending in a distinct point.

Pupa.—Dorsum of thorax smooth, without definite reticulations or designs. The respiratory apparatus of each side is composed of eight tubular filaments, arranged in two main trunks, each trunk branched near its base to form two groups of 2–1–1 filaments; the branching is so close to the base that all filaments superficially appear to be simple.

Cocoon: Length of base, 3.7 mm.; greatest length, 4.2 mm.; greatest width, 1.8 mm.; extent of collar from base, 1.1 mm. Case slipper-shaped, with distinct collar and fine parchment-like texture; lateral margins of cocoon not extended to form "wings". Extending from the rim around the anterior aperture are several ribbon-like festoons, those of each side being united (Fig. 7); the number of festoons and the exact configuration they assume is not constant.

Simulium **(*D.*)** ***acatenangoensis*** appears quite similar to *S.* (*D.*) ***virgatum*** Coq. (1, 10), *S.* (*D.*) ***rubicundulum*** Knab (11), and *S.* (*D.*) ***mathesoni*** Vargas (12). It can be readily distinguished from ***virgatum*** as follows: The abdomen of the female ***virgatum*** is light brown with all the segments at least partially grey-pruinose above while that of ***acatenangoensis*** is black with only the tergites of the first two segments bearing white pruinosity. The apical angle of the expansion of the genital fork of ***acatenangoensis*** is more acute and much more heavily sclerotized than in ***virgatum***. The outer basal angle of the former is more elongate with the tip blunt. The base color of the mesonotum and of the abdomen of the male ***acatenangoensis*** is completely black and the sternites are light brown with a median, longitudinal black band, while the mesonotum and abdomen of ***virgatum*** are dark rusty-brown and the sternites are all light tan-pruinose. The side-piece of ***acatenangoensis*** appears almost square; the clasper has its outer margin well-curved and its apex rather blunt, usually with two spines. *S.* ***virgatum*** has the side-piece rectangular; the clasper is rather straight along its outer margin and the apex is rounded with usually one spine. The median prolongation of the adminiculum is shorter and narrower, and the basal prolongations are broad and spatulate in this new species, while in ***virgatum*** the basal prolongations are long, narrow, and pointed. *S.* ***virgatum*** is a larger species. The pupal filaments are arranged in two groups of two filaments, and four single ones, while in ***virgatum*** they are arranged in two groups of three filaments, and with only two single ones.

S. ***acatenangoensis*** can most easily be distinguished from ***rubicundulum*** by the following characteristics of the latter species: The apical margin of the adminiculum is straight with a very long, slender median prolongation emerging perpendicular to it. The clasper is not as curved on its outer margin as that of ***acatenangoensis*** and it bears only one apical spine. The mesonotum of the female is evenly clothed with golden-yellow, scale-like hairs. The outer basal angle of the expansion of the genital fork is almost 90°. The pupal filaments are arranged like those of ***virgatum.***

S. acatenangoensis appears closest to *S. mathesoni*, but the following points of difference will establish their individuality: The abdomen of the female *mathesoni* is dark brown with the posterior margins of segments two through seven being grey-pruinose. The sternites of the abdomen of the male *mathesoni* are evenly pruinose rather than being shiny light brown with a median, longitudinal, black band, as in *acatenangoensis*. The hind femur of the male *mathesoni* is yellow, with sub-basal and apical dark brown rings and the basitarsus is almost completely yellow; in *acatenangoensis* the femur is dark brown except for a minute yellow section at base and a sub-basal black ring, and the basitarsus is yellow only on its basal half. The pedisulcus of the same leg is much deeper in *acatenangoensis*. The adminiculum of *acatenangoensis* has the median prolongation narrower, the lateral margins of the latter being parallel rather than converging toward the apex. The body of the adminiculum of *acatenangoensis* is narrower and the basal prolongations are longer. The latter structures are broad and hyaline, each ending in a spatulate plate with finger-like extensions; in *mathesoni* these are narrower, more heavily sclerotized, each ending in a rather sharp point. The arms of the adminiculum of *acatenangoensis* have the teeth at the apex concentrated to form a dome-shaped structure while in *mathesoni* the teeth are more dispersed. The clasper of the former species has two apical spines instead of one. The genital rod of the same species has the basal dilatation short, forming almost an equilateral triangle, while in *mathesoni* the dilatation is more elongate and oval.

The material used for comparison with *acatenangoensis* is the following:

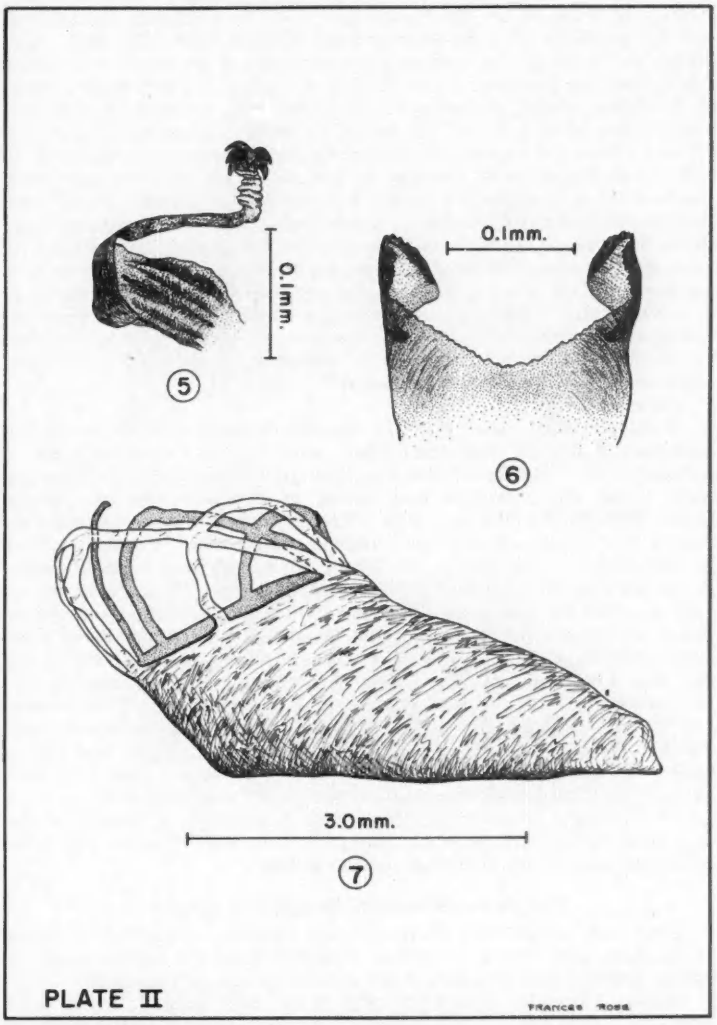
Simulium (*Dyarella*) *virgatum* Coquillet: One male, one female, and their cocoons collected in Hutto, Texas. These were loaned to the author by the U. S. National Museum at the request of Dr. Alan Stone. Descriptions and drawings of Stone (10).

Simulium (*Dyarella*) *rubicundulum* Knab: Several males, females, and their cocoons collected on the Finca El Vergel, Chiapas, México, and given to the author by Dr. Luis Vargas. Also hundreds of specimens collected in various parts of Guatemala and reared in the Onchocerciasis Laboratory. Drawings of male and female genitalia by Vargas (11).

Simulium (*Dyarella*) *mathesoni* Vargas: One male, one female, and their cocoons collected in Gulatao, Oaxaca, México, and given to the author by Dr. Luis Vargas. Also several specimens collected in Guatemala and reared in the Onchocerciasis Laboratory, some of which were compared with the type by Dr. Vargas. Drawings of male genitalia and cocoon by Vargas (12).

After studying the above material the author does not concur in the synonymy of Stone (10) in which *rubicundulum* Knab and *mathesoni* Vargas are considered as being the same as *virgatum* Coquillet. Each of these species, as well as *acatenangoensis*, is believed to be distinct, the latter species being very close to *mathesoni*. In the same paper by Stone, *hippovorum* Malloch is also considered a synonym of *virgatum* Coquillet. Since the author has not examined the specimens of Malloch personally, no comments can be offered at this time.

Ecological Notes.—To date, *Simulium* (*D.*) *acatenangoensis* has been



Simulium (*Dyarella*) *acatenangoensis*, n. sp. FIG. 5. Adminicular arm and lateral plate. FIG. 6. Bucco-pharyngeal apparatus of female. FIG. 7. Cocoon (in profile).

found only in the regions of Acatenango and Yepocapa, Chimaltenango. The streams are all on the Pacific slopes of the volcanoes Acatenango and Fuego at an altitude ranging from 3600 to over 5000 feet. The ranges and averages for various characteristics of the streams in which this species has been found are: Width, 12 inches to 7 feet with average of 27 inches; depth, 2 inches to 17 inches with average of 3 inches; temperature of stream, 10° C. to 21° C. with average of 17° C.; pH, 7.0 to 7.4 with average of 7.2; current speed, 7.3 inches per second to 16 inches per second with average of 9.1; depth at which pupae were encountered, 0.5 inches to 2 inches with average of 1 inch. In all cases the streams had either muddy or sandy beds, with both small and large stones in abundance, with much emergent vegetation, and shaded by trees and shrubs. Although the pupae were found on leaves on two occasions and on twigs on another, the preference of the pupae seems to be a substratum of stones over which a cascade of water is running. The species is prevalent throughout the year. Other species of blackflies found in the same streams are: *S. callidum*, *mexicanum*, *metallicum*, *capricornis*, *rubicundulum*, and *downsi*.

Types.—

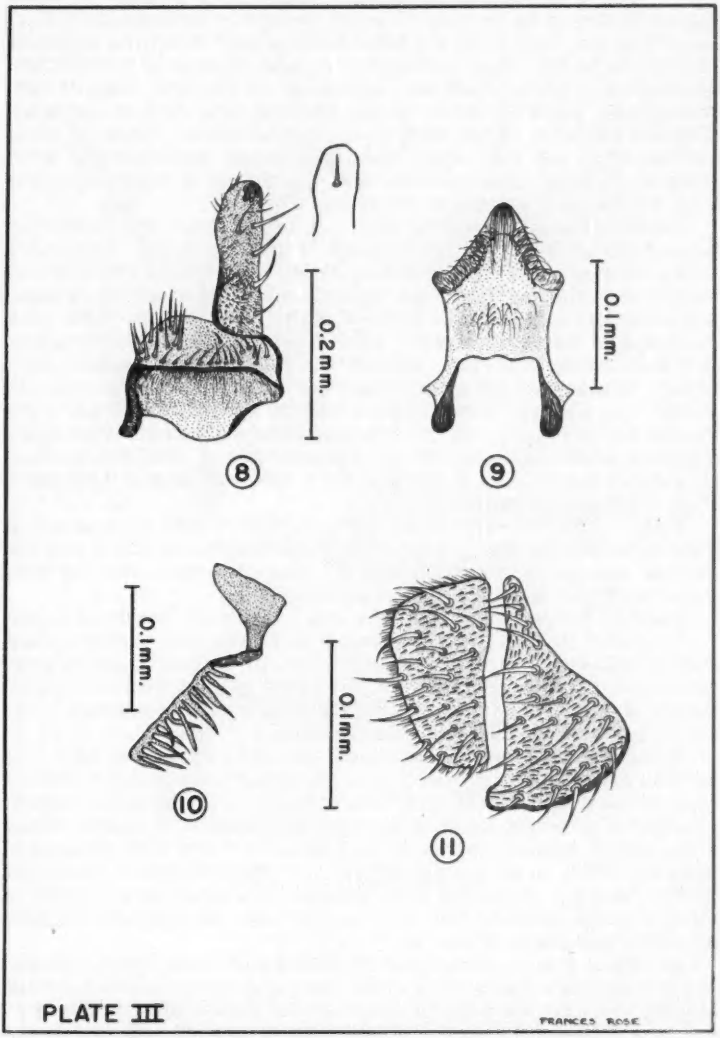
Holotype: Male (Acat. 409–27) reared from pupa collected in the Río Ladrillera, Finca La Esperanza Pérez, Acatenango, Chimaltenango, on November 25, 1948 by Alfonso Calí and Juan Marroquín; mounted on three slides, pupal exuviae and cocoon in alcohol. *Allotype:* Female (Acat. 409–33) reared from pupa collected with holotype; mounted on four slides; pupal exuviae and cocoon in alcohol. *Paratypes:* Two females and one male (Acat. 748–38, 39, 55) reared from pupae collected in the Río La Torre, Finca La Torre, Acatenango, Chimaltenango, on July 4, 1949 by Domingo Montúfar and José Rosales; mounted on slides; the pupal exuviae and cocoons in alcohol. Three males and three females (Acat. 516–1, 5, 6, 2, 3, 4) reared from pupae collected in the Río San Diego, Finca San Diego, Acatenango, Chimaltenango, on December 16, 1948 by José Rosales and Daniel Luch. Two females and two males (Acat. 601–1, 9, 2, 4) reared from pupae collected in the Río San Diego on March 30, 1949 by Domingo Montúfar and Daniel Luch. All specimens from accessions 516 and 601 are pinned on cork mounts, their pupal exuviae and cocoons preserved in alcohol.

The holotype, allotype, and four paratypes (601–1, 9, 2, 4) have been deposited in the collection of the U. S. National Museum; all other paratypes are in the collection of the author.

Simulium (Simulium) kompi, new species

Only two pupae have been collected to date. Descriptions follow of the male and female genitalia, dissected from the formed imagines still in their pupal cases, and of the cocoon and pupal filaments.

Male.—Genitalia: Side-piece (Fig. 8) 0.14 mm. long, 0.17 mm. wide, with no outstanding projections or prominences. Clasper (Fig. 8) 0.18 mm. long, irregularly rectangular, the outer margin with a gentle central indentation and a slight swelling at its base; apical spine bifid and blunt; on the ventral face, about one-quarter of the length from the apex, there is one very strong, heavily sclerotized spine that appears unique for this species. Body of adminiculum (Fig. 9) longer than



Simulium (*Simulium*) *kompi*, n. sp. FIG. 8. Side-piece and clasper of male (dorsal view) and ventral view of apex of clasper to show heavily-sclerotized spine. FIG. 9. Adminiculum of male (ventral view). FIG. 10. Adminicular arm and lateral plate. FIG. 11. Cercus and anal lobe of female.

broad, with a distinctive pentagonal shape: Apex in form of blunt angle with both sides forming the angle completely clothed with numerous rather long, wavy hairs; similar hairs present in central region of adminicular body. Basal prolongations of adminiculum well sclerotized, terminating in broad, spatulate expansions; on the outer edge of each prolongation, reaching almost to the terminal expansion, is a hyaline, wing-like extension of the body of the adminiculum. Arms of adminiculum (Fig. 10) with approximately fourteen well-separated teeth along their distal three-quarters, some of the teeth being extremely long; lateral plate irregularly triangular in shape.

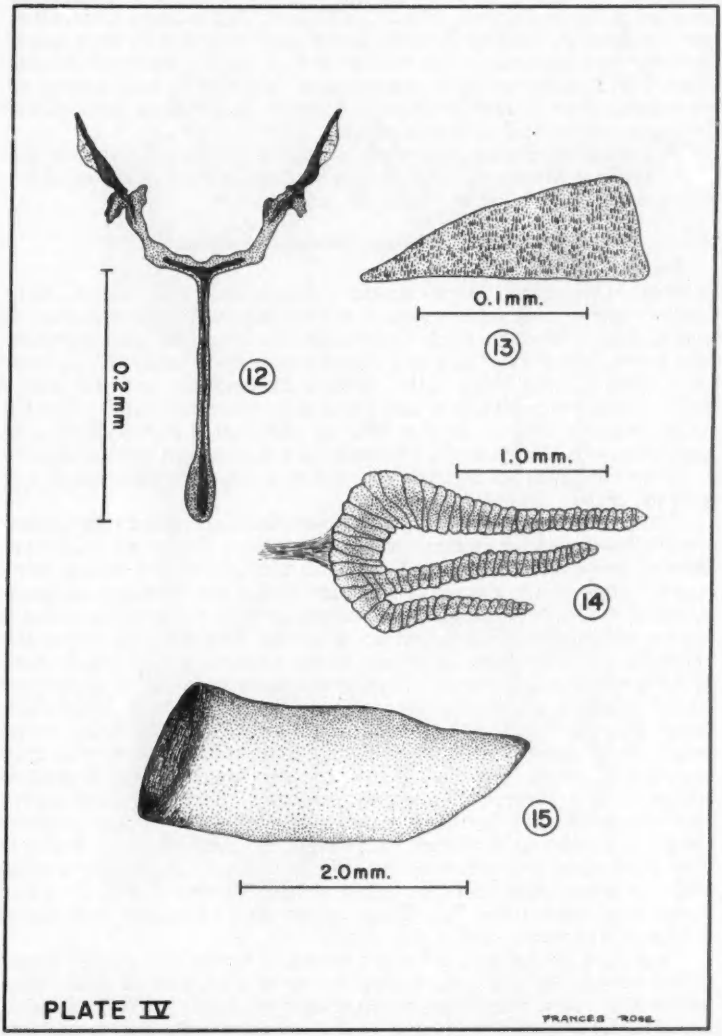
Female.—Genitalia: Cercus (Fig. 11) higher than long, somewhat tapered below, with posterior margin rounded; clothed with many strong hairs and numerous minute, spine-like hairs. Anal lobe (Fig. 11) semicircular with the dorsal end tapered and extended to form a neck; posteroventral extremity in form of slight protuberance; with same investiture of hairs as on cercus. Genital rod (Fig. 12) with rather extensive basal ovate dilatation; distally the rod branches broadly, each branch bearing two irregular, triangular-shaped expansions near its middle, and a heavily sclerotized and pointed apex; at the center of the interior border between the two branches there is a definite indentation; a hyaline, wave-like expansion extends from apex of each branch, along the exterior margin, almost reaching the median expansions. Ovipositor (Fig. 13) short and broad.

Pupa.—Breathing apparatus (Fig. 14) of each side is composed of three tube-like filaments arranged with the longest one above and the shortest one below; they measure 2.1 mm., 1.8 mm., and 1.3 mm. respectively; all filaments appear annulated.

Cocoon: Longest dimension, 3.4 mm.; widest dimension, 2.2 mm. Case (Fig. 15) with roof subparallel to substratum; ventral surface with its mid-region fixed to the substratum, its anterior fourth slightly raised and its posterior third markedly raised to meet the roof; ventral surface woven along approximately the posterior three-quarters of its extent; anterior aperture somewhat thickened.

Simulium (*S.*) ***kompi*** appears closest to *S.* (*S.*) ***tricornis*** de Léon (14) but can easily be distinguished from the latter species by the form of the adminiculum, the bifid condition of the apical spine of the clasper, presence of a unique heavy spine on ventral surface of clasper; shape of the cercus, longer dorsal neck-like extension of anal lobe, presence of basal dilatation on genital rod, difference in form of median extensions of the branches of genital rod, presence of identation at center of interior margin between the branches, form and arrangement of pupal filaments, and shape of cocoon.

Ecological Notes.—Both pupae of *Simulium* (*S.*) ***kompi*** were collected in a stream on the Pacific slope of the volcano Acatenango at an altitude of 6300 feet. At the point of collection the stream had a width of 24 inches, a depth of 3 inches, a temperature of 16.5° C., pH of 7.4, and current speed of 14 inches per second. The stream bed was sandy, with small and large stones, and with very little emergent vegetation. High bushes on both banks shaded the collection spots. The pupae were found at a depth of one inch, one on a stone, the other on a leaf. Other species of simuliids found associated with ***kompi*** in the same stream were: *S.* ***capricornis***, ***nigricornis***, and ***metallicum***.



Simulium (*Simulium*) *kompi*, n. sp. FIG. 12. Genital rod of female. FIG. 13. Ovipositor. FIG. 14. Respiratory apparatus of pupa. FIG. 15. Cocoon (in profile).

Types.—Holotype: Male (Acat. 697–9) dissected from mature pupa collected in the Río Ciprés, Aldea Los Pajales, Acatenango, Chimaltenango, on June 15, 1949 by Roverto Marroquín; mounted on three slides, the pupal exuviae and cocoon preserved in alcohol. *Allotype:* Female (Acat. 708–2) dissected from mature pupa collected in same stream as holotype on June 6, 1949 by Enrique Castillo; mounted on three slides, the pupal exuviae and cocoon in alcohol.

Both type specimens have been deposited in the collection of the U. S. National Museum. The species has been named in honor of the distinguished entomologist, W. H. W. Komp.

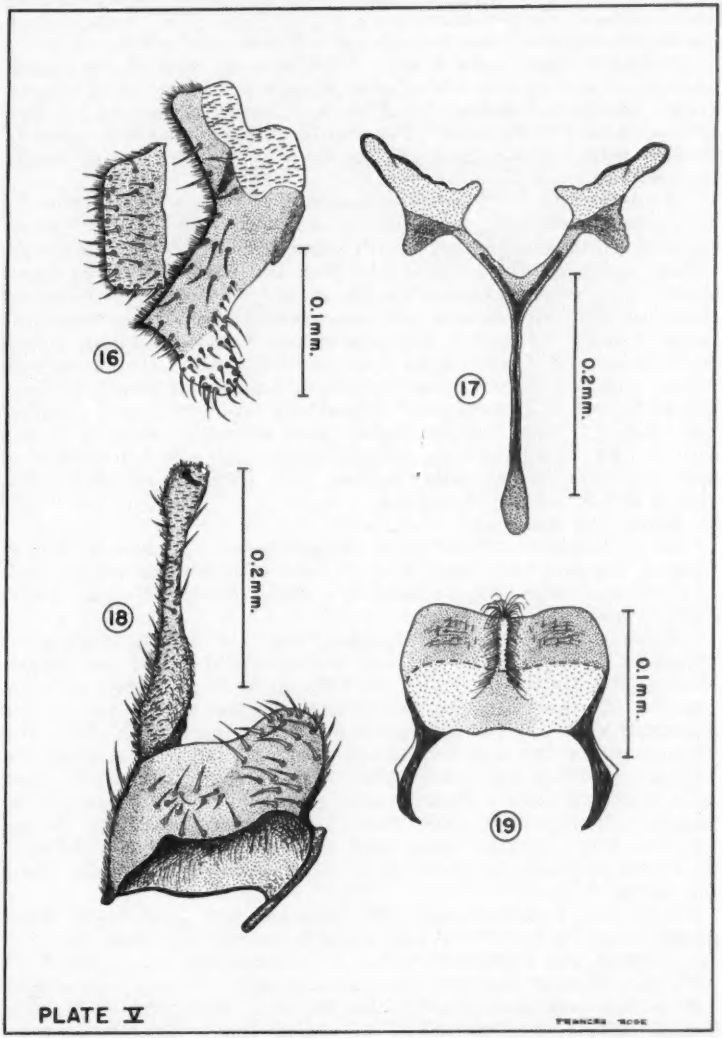
Simulium (Hearlea) burchi, new species

Female.—2.5 mm. long.

Head: Dichoptic. Eyes black. Antennae 11-segmented, only slightly tapered; first segment small, second and third segments of equal length, fourth through sixth short and disc-like; first two segments light brown, the others black and covered with white pruinosity. Palpi black, clothed with black hairs. Frons, clypeus, and occipital region black, covered with white pruinosity and numerous black hairs. Fronto-ocular triangle 24μ in height, 60μ at the base. Bucco-pharyngeal apparatus with cornua heavily sclerotized and indented at their apices; border of median space hyaline, with a definite median indentation, and without spines.

Thorax: Mesonotum black, with short black appressed hairs rather evenly distributed throughout; when viewed from above, with the head directed forward and downward, and with the light source from in front at a 45° angle to the specimen, there are visible two isolated, subquadrangular, white pruinose patches contiguous with the anterior margin, one on either side of the midline; extending longitudinally along the mid-region of the notum are three white pruinose bands which unite with the white pruinose patch covering the posterior fourth of the notum; lateral margins white pruinose; prescutellar region with long black hairs; a broad band of appressed, golden-yellow scales along entire periphery of notum. Scutellum black, completely clothed with grey pruinosity, several long black hairs, and few long, appressed, golden-yellow scales. Pleurae evenly grey pruinose. Postnotum black with two triangular grey pruinose patches contiguous with the anterior margin and meeting at the midline; devoid of hairs or scales. Halteres with black stem and yellow knob. Wings, 2.9 mm. long; base of costa with numerous black hairs; Sc pilose along basal two-thirds; R_1 pilose along distal three-fifths; R_{2+3} simple, pilose except for short bare region at base; Cu_2 arcuate; discal cell absent.

Legs: Leg 1—Length, 2.5 mm.; coxa and trochanter yellow; femur yellow except for slight darkening on outer edge and at apex; tibia yellow with apical black ring; tarsus completely black. Leg 2—Length, 2.4 mm.; coxa black, trochanter dark with apex yellowish; femur and tibia yellow, the apex of each with black ring; basitarsus yellow on proximal half, the distal half black; all other tarsal segments black. Leg 3—3.0 mm.; coxa black, trochanter yellow; femur and tibia with same color patterns as on leg 2; tarsus with basal half of basitarsus and basal third of second tarsal segment yellow, the apical parts of these



Simulium (*Hearlea*) *burchi*, n. sp. FIG. 16. Cercus and anal lobe of female. FIG. 17. Genital rod of female. FIG. 18. Side-piece and clasper of male (dorsal view). FIG. 19. Adminiculum of male (ventral view).

segments, and all other tarsal segments, black; calcipala and pedisulcus well-developed, the pedisulcus being situated very close to the base of the second segment; claw strongly curved, with submedian tooth.

Abdomen: Basic color black. First segment with dorsum grey-pruinose; second segment with similar pruinosity in a band along anterior margin; segments 3 through 5 dull black, 6 through 8 shiny and clothed with semi-erect black hairs. Pleurites of all segments black, those of the first with posterior fringe of long black hairs. Sternites all evenly tan-pruinose.

Genitalia: Cercus (Fig. 16) subquadrangular, longer dorso-ventrally than antero-posteriorly, dorsal margin wave-like, the posterior corners rounded; entire surface clothed with many strong hairs and numerous minute, spine-like hairs. Anal lobe (Fig. 16) also longer in its dorso-ventral dimension; posterior margin evenly curved, anterior margin irregularly curved; posterior half and median region of anterior half rather heavily sclerotized, the posterior half with numerous strong hairs; dorsal and ventral angles of anterior half hyaline, the former with minute, spine-like hairs similar to those on cercus, the latter with hairs similar to those on posterior half of anal lobe but of finer form. Genital rod (Fig. 17) with well-developed basal dilatation, oval in shape; genital fork with branches narrowly divergent; apical expansion of each branch triangular, rather hyaline, with all angles rounded. Ovipositor of medium size, triangular.

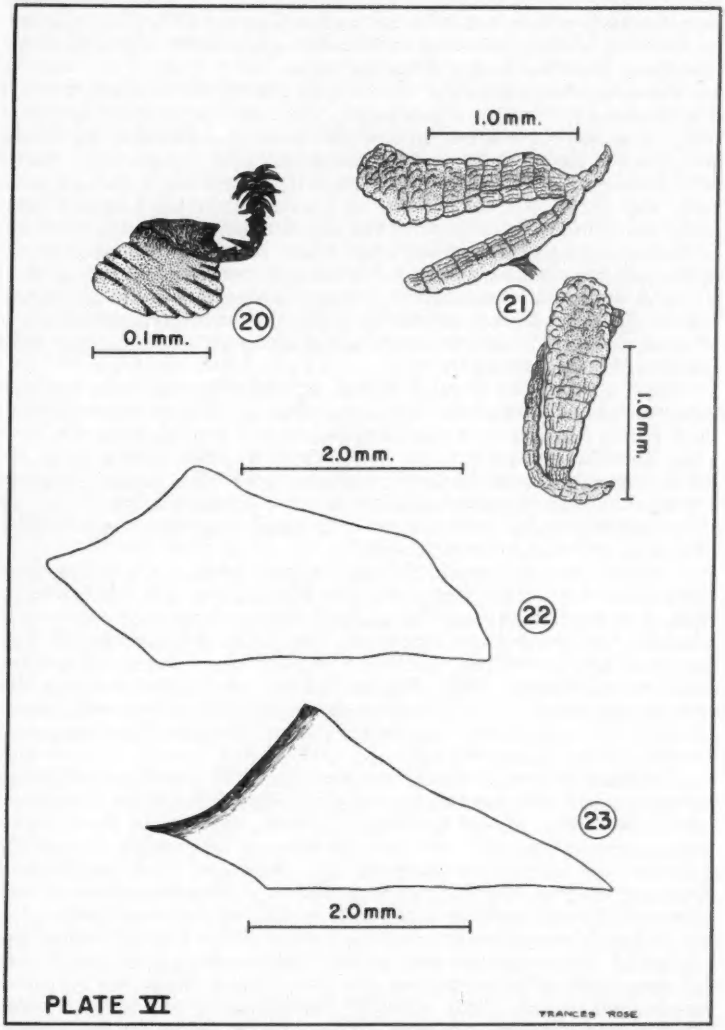
Male.—2.5 mm. long.

Head: Holoptic. Eyes dark reddish-brown. Antennae 11-segmented, the first two segments dark reddish-brown, the others black and covered with grey pruinosity. Palpi black. Clypeus black, covered with white pruinosity.

Thorax: Mesonotum velvety-black with no central longitudinal stripes or bands; when viewed from above, with the head directed forward and downward, and with the light source from in front at a 45° angle to the specimen, the two humeral angles and the prescutellar depressed area appear white-pruinose; black hairs cloth the entire notum; around the periphery of the notum is a band of sparsely distributed, narrow, appressed, golden-yellow scales. Scutellum black with long black hairs. Pleura evenly grey-pruinose. Postnotum as in female. Halteres with dark brown stem and yellow knob. Wings, 3.1 mm. long; Sc pilose along basal sixth; R_1 pilose along distal half; R_{2+3} simple, pilose except for small basal region; Cu_2 arcuate; discal cell absent.

Legs: Leg 1—Length, 2.8 mm.; coxa and trochanter black; femur black except for the ventral face which is covered by yellow pruinosity and clothed with appressed, golden-yellow, scale-like hairs; tibia black with band of silver pruinosity along outer margin, the band being clothed with several appressed, silvery, scale-like hairs; tarsus completely black. Leg 2—Length, 2.5 mm.; entire leg black. Leg 3—Length, 3.2 mm.; leg black except for proximal half of basitarsus and proximal third of second tarsal segment, which are yellow; tibia and tarsus very broad and spatulate; calcipala absent, pedisulcus present.

Abdomen: Tergites velvety-black with silver pruinosity on anterior margin of second segment. All pleura black; those of first segment



Simulium (*Hearlea*) *burchi*, n. sp. FIG. 20. Adminicular arm and lateral plate. FIG. 21. Left respiratory apparatus of pupa (in profile and dorsal view). FIG. 22. Cocoon collected from twigs in Nebaj (in profile). FIG. 23. Cocoon collected from stones in Cuilco (in profile).

with posterior fringe of long black hairs; pleura of third and fourth segments each with tuft of black hairs extending outwards, perpendicular to the body surface; pleurites of fifth through seventh segments grey-pruinose. Sternites evenly tan-pruinose.

Genitalia: Side-piece (Fig. 18) wider than long, with marked swelling of external apical angle. Clasper (Fig. 18) very long and narrow, both margins somewhat curved, with slight basal protuberance on dorsal side; apex expanded and truncate, with rather long apical spine. Body of adminiculum (Fig. 19) quadrangular, wider than long; basal processes long, well-sclerotized, and ending in points; extending longitudinally along the midline of the body of the adminiculum is a raised, keel-like structure which is clothed with fine hairs; on the dorsal surface the apical half of the adminiculum is doubled over to form a pocket-like flap which is clothed with short hairs (edge of flap is represented by dotted line on Fig. 19). Arm of adminiculum (Fig. 20) with teeth concentrated at apex, one large tooth present half-way along its length; lateral plate subquadrangular, wrinkled.

Pupa.—Thorax of pupa without any pattern; abdomen without terminal spine. Respiratory apparatus (Fig. 21) of each side horn-like, with dorsal, ventral, and posterior elements; dorsal element 1.3 mm. long, club-like, especially when viewed from above, and with its upper surface somewhat tuberculated near the apex; the ventral element passes around the anterior aperture of the cocoon, with which it is in close apposition; all elements of respiratory apparatus superficially annulated and with cross-striations.

Cocoon: Greatest length, 3.7 mm.; greatest width, 1.5 mm.; greatest height, 1.5 mm. Case slipper-shaped (Figs. 22 and 23), with distinct collar and fine, parchment-like texture; lateral margins of cocoon not extended to form "wings"; posterior two-fifths of base woven. The cocoon of this species has been found in two distinct forms. The form found on petioles and twigs (Fig. 22) has the collar more erect and the dorsum humped; the form found on stones (Fig. 23) has the collar more inclined, the rim around the anterior aperture somewhat thickened, and the dorsum almost straight.

Simulium (*Hearlea*) *burchi* appears closest to *Simulium* (*Hearlea*) *dalmati* Vargas (15), but the two can be separated as follows: Considering the female, in *burchi* the frons has black hairs only; the anterior white-pruinose patches on the mesonotum are subquadrangular, isolated, and not very extensive, and there are three longitudinal pruinose bands on the notum; in *dalmati* the frons has silver as well as black hairs, the anterior patches are in the form of isosceles triangles, the posterior angle of each extending backward to form a longitudinal band, and the patches are so large that they occupy approximately the anterior third of the notum; in the latter species there are only two longitudinal bands. The male of *burchi* has golden-yellow scales concentrated along the periphery of the scutum, while in *dalmati* these are generally distributed. The Sc of *burchi* is pilose along its basal third rather than with a few isolated hairs. In *burchi* the ventral face of the anterior femur is covered by golden-yellow scale-like hairs, the second pair of legs is completely black, the tibia of the hind leg is entirely black, and the calcipala of this same leg is absent; in *dalmati*

there are no scales on the legs, the basal third of the tibia of both the second and hind legs is yellow, and the calcipala reaches the border of the pedisulcus. The clasper of ***burchi*** is longer and more curved than in ***dalmati***, and its apex is well-expanded and truncate. The adminiculum of ***burchi*** with definite longitudinal keel on ventral surface and the basal processes are pointed terminally; adminiculum of ***dalmati*** without keel and with the basal processes moderately expanded at their apices. The cocoon of ***burchi*** is much smaller, of finer texture, and with a more erect collar than that of ***dalmati***.

Ecological Notes.—

Simulium (***Hearlea***) ***burchi*** has been found in only two places, one at an elevation of 8800 feet in the Aldea Yulvá, Municipality of Cuilco, Department of Huehuetenango, and the other at an elevation of 7250 feet in Nebaj, Department of Quiché, which is situated on the slopes of the Sierra de los Cuchumatanes. Both streams in which the pupae were taken were approximately 1.5 meters wide, varied from 3 to 8 inches in depth, and had a pH of 7.4. The pupae were found in cascades of water, on twigs and leaf stems in Nebaj, and on small stones and on a stone-like substratum in Cuilco. In Nebaj the larvae and pupae were also found in a less rapid part of the stream with a current of 20 feet per second. At Cuilco the stream-bed was composed of a hard clay, while at Nebaj it was sandy. Both streams contained numerous small stones and few emergent plants. As will be noted under the description of the pupa, the cocoons from these two localities differ, probably due to the different substratum to which they were attached. In both streams the pupae were found at a depth of one inch. In Cuilco the collecting spot was open to the sun, while in Nebaj it was shaded by thick vegetation. Other species of blackflies found breeding in the same stream in Nebaj are: *S. **veracruzanum**, **microbranchium**, **callidum**,* and ***ochraceum***.

*Types.—**Holotype:*** Female (Accession 8X–3) reared from pupa collected in the Río Micovez, Nebaj, Quiché, on November 15, 1949 by J. Onofre Ochoa A., Miguel A. Rodriguez, and Herbert T. Dalmat; adult on cork mount, pupal exuviae and cocoon in alcohol. ***Allotype:*** Male (Accession 8X–10) reared from pupa collected with holotype; mounted on three slides of wings, legs, and genitalia, the pupal exuviae and cocoon in alcohol. ***Paratypes:*** Three females and one male (8X–1, 2, 8, 7) reared from pupae; all mounted on cork blocks except one female (8X–8) which has been prepared on 5 slides. Two males (8X–12, 13) dissected from well-developed pupae; a single slide prepared of the genitalia of each, the remainder of the specimens discarded. Five pupae (8X–14). Above-mentioned paratypes were collected along with the holotype. One female (9I–1) dissected from pupa collected in the Río Yulva, Aldea Yulvá, Cuilco, Huehuetenango, on February 27, 1949 by J. Onofre Ochoa A. and Roberto Feoli; mounted on three slides. One pupa (9I–2). The pupal exuviae and cocoons of all paratypes have been preserved in alcohol.

Holotype and allotype have been deposited in the collection of the U. S. National Museum; paratypes in collection of author. This species has been named in honor of Dr. Thomas A. Burch, of the National Institutes of Health, chief of the Guatemalan onchocerciasis project of the Pan American Sanitary Bureau.

Cnephia roblesi (de León), n. comb.

Simulium roblesi de León, 1943. Preliminares para la descripción de cinco nuevas especies de simúlidos en Guatemala. Bol. Sanit. Guatemala 51: 94–101.

This species, originally assigned to the genus *Simulium* by de León (5), is found to belong actually in the genus *Cnephia*. The wing of the female has the subcosta pilose along its entire length, the hairs being less concentrated toward the apex, the veins R_1 and R_{2+3} are completely pilose, the vein Cu_2 arcuate, and the discal cell present. The legs of the female are predominantly of one color, the hind tarsus has a well-formed calcipala, but lacks the pedisulcus; the claw is long and slender, without median or subbasal tooth, but with the base extended to form a spatulate process. The segments of the female antenna, with the exception of the terminal one, are all of approximately the same width. The ovipositors are short, the inner borders of the two being parallel to each other, and ending in a right angle. The clasper of the male genitalia is short, conical, and bears two terminal spines. The pupa has two long, sharp, terminal spines. The cocoon is composed of an irregular mass of soft, wool-like material which hardly reaches the cephalothorax.

Cnephia roblesi represents the first species of the genus *Cnephia* to be reported from Central America. Vargas (15) recently described *Cnephia grenieri*, the first member of this genus to be found in Mexico. Plesiotypes: Two males and two females (7Y–1, 2, 3, 4) in collection of author.

Cnephia pacheco-lunai (de León), n. comb

Simulium pacheco-lunai de León, 1944. Nuevas especies de simúlidos en la región occidental de Guatemala. Bol. Sanit. Guatemala 52: 66–77.

In his original description de León (6) described only the respiratory apparatus of the pupa, placing the species in the genus *Simulium*. Although the complete description of this species will be left for a future paper, sufficient is here presented to assign it to its proper genus, *Cnephia*. The female has the wing vein Sc pilose along the basal four-fifths of its length, veins R_1 and R_{2+3} pilose along their entire extent, Cu_2 arcuate, and the discal cell present. The legs of the female are almost entirely of a single color; the hind tarsus has a well-formed calcipala but lacks a pedisulcus; the claw is long and slender, without any median or subbasal teeth, but with the base extended to form a spatulate process. The ovipositors are short, triangular, with the inner borders parallel, and terminating in right angles. The clasper of the male genitalia is conical, with two terminal spines. The pupa bears two very sharp terminal spines, and the cocoon is loosely woven, relatively short, not assuming a definite form.

Cnephia pacheco-lunai is the second representative of this genus to be reported from Central America, the first being *Cnephia roblesi* (de León, 1943). Plesiotypes: Two males (8Q–2, 3) and two females (8Q–1 and 7Y–14) in collection of author.

Cnephia aguirrei (Dalmat), n. comb.

Simulium (*Eusimulium*) *aguirrei* Dalmat, 1949. New species of Simuliidea (Diptera) from Guatemala—1. Ann. Ent. Soc. Amer. 42(4): 538–553.

In the original description (2) the author incorrectly placed this

species in the subgenus *Eusimulium* of the genus *Simulium* instead of in the genus *Cnephia*. This error was based upon the apparent presence of calcipala, pedisulcus, and pilosity on the postnotum. The specimens used for the original description were dissected from their pupal cases and all parts were mounted on slides. Undoubtedly, hairs emerging from the scutellum had broken loose and were mistaken for postnotal hairs; a fold or wrinkle in the posterior tarsus may have been interpreted as a pedisulcus. With the rearing of another adult female, it has been possible to correct the above errors; place this species in its proper genus, and add to the original description.

Female.—Length, 3.5 mm.

Head: Eyes dichoptic, comparatively small, reddish-brown. Frons so very narrow that the eyes appear almost holoptic. Antennae 11-segmented; the basal two segments are yellow with black hairs, more concentrated at the apices where they form two to three irregular rings around the segments; the other nine segments are orange-yellow, clothed with short silvery hairs; first three segments and the last one longer than wide, the others wider than long; all segments, with the exception of the terminal one, approximately equal in width. Palpi black with yellowish pruinosity and stiff black hairs. Frons, clypeus, and occipital region black, covered with pale yellowish pruinosity and with narrow, appressed, pale yellowish, scale-like hairs, some of the latter appearing almost silvery. Frons and occipital region also invested with several longer, fine, black hairs.

Thorax: Mesonotum evenly black with a slight bluish-grey cast; texture somewhat granular; without pruinose bands, stripes, or lines; appressed, pale yellowish, scale-like hairs clothing the notum, more numerous along the periphery and on the posterior half; several long, stiff, black hairs along posterior margin. Scutellum brownish-yellow, with the same scale-like hairs as on the mesonotum; also clothed with numerous long black hairs which curl toward the midline. Postnotum dark brown with faint grey pruinosity. Pleura dark brown with tan pruinosity. Halteres tan throughout. Wings, 3.0 mm. long and 1.2 mm. at their widest point, somewhat infuscated; costa with both haris and spines; Sc and R_1 pilose along their entire length; R_{2+3} simple, not branched, with hairs along its entire extent except for a very small basal region; Cu_2 arcuate; discal cell well formed.

Legs: The general color pattern for all the legs is as follows: Coxa dark brown, trochanter with basal half tan, distal half dark brown (trochanter of leg 3 is an exception in that it is completely tan); femur tan with small dark brown apical ring; tibia tan with basal and apical darker rings; tarsus completely tan. The femora and tibiae heavily clothed with stout black hairs; the tarsi clothed with shorter and finer black hairs and with appressed, pale yellow, scale-like hairs. The posterior tibiae and tarsi are hardly expanded. Calcipala well-developed, pedisulcus lacking. Claw simple and slender with the base prolonged.

Abdomen: Tergites of first segment light brown with tan pruinosity; second segment divided transversely so that the anterior half is colored like the preceding segment, while the posterior half is colored like the third through seventh segments; tergites of the latter segments are

black, each with a central quadrangular tan patch extending from the anterior to posterior margin of the segment; tergites of eighth and ninth segments of same color as on segment one. Pleural regions of all segments black. Entire dorsal region of all segments clothed with numerous appressed, pale yellow to greyish hairs. Sternites of segments one through six dark brown, sternite of segment seven tan-pruinose.

Pupa.—Dorsum of thoracic region tuberculated and marked with dark spots; trichomes absent. At the posterior end of the pupa are two rather long, very sharp terminal spines which hook into the cocoon, thereby anchoring the pupa. The cocoon is very short in comparison with the length of the pupa, hardly covering the entire abdominal region of the latter, and leaving the cephalothorax completely exposed. It has a particularly thick but soft, fibrous texture, very much like wool, which resists breaking.

Cnephia aguirrei is the third representative of this genus in Central America, *Cnephia roblesi* and *Cnephia pacheco-lunai* being the other two. (See discussion of these two species elsewhere in this paper). Metatype: Female (Acat. 9–14) in collection of author.

Gigantodax (Gigantodax) aquamarensis (de León), n. comb.

Simulium aquamarensis de León, 1944. Nuevas especies de simúlidos en la región occidental de Guatemala. Bol. Sanit. Guatemala 52: 66–77.

This species, originally described by de León (6) as belonging to the genus *Simulium*, is considered by the present author to represent the second species of the genus *Gigantodax* found in Central America, the first being *Gigantodax* (*G.*) *wrighti* Vargas, 1944. The characteristics of *aquamarensis* fit well within the diagnosis of the genus *Gigantodax* as given by Smart in 1945 (9): The radial sector is simple, unbranched, somewhat sinuous, with a single row of macrotrichia on upper side along entire extent except for small basal section; basal section of radius with macrotrichia on upper side; macrotrichia of costa both bristle-like and spiniform; Cu_2 straight; An_1 straight, terminating somewhat farther from the end of Cu_2 than in other genera. Coxae rather less hairy than in other genera; hind basitarsus narrow, parallel-sided and exceptionally long, equalling tibia in length and more than twice as long as other tarsal segments taken together; pedisulcus absent; calcipala present, exceptionally long and wide; claw with strong basal tooth. The pupa bears two terminal spines. An intermediate condition is found in *aquamarensis* between the wing with a discal cell and the wing without it. Since all other characteristics are those of *Gigantodax*, and since the discal cell is not completely enclosed, *aquamarensis* should be included in that genus. Plesiotypes: Two females (6K–3, 4) in collection of author.

Simulium (Hearlea) microbranchium Dalmat

Simulium (*Simulium*) *microbranchium* Dalmat, 1949. New species of Simuliidae (Diptera) from Guatemala—I. Ann. Ent. Soc. Amer. 42(4): 538–553.

In the original description (2) this species was incorrectly placed in the subgenus *Simulium* instead of in *Hearlea*. The subgeneric characters, especially those of the shape of the clasper and adminiculum in the male, and the tubular form of the respiratory apparatus in the pupa

demonstrate the relationship between this species and others in the subgenus *Hearlea*.

In the original description of this species only the genitalia were included for the male since the adult form of this sex had been dissected from the pupal case, and the condition of the remainder of the specimen precluded further description. Since that time several pupae of this species have been collected and reared to adults. A description of the male, exclusive of the genitalia, follows.

Male.—2.8 mm. long.

Head: Eyes holoptic, dark reddish-brown. Antennae 11-segmented, rather short, deeply inserted; first two segments dark brown, the others black; third segment almost one and one-half times as long as the second segment; fourth through eleventh segments narrower than the others, so curved that they appear to form a spiral flagellum; third through eleventh segments with numerous short yellow hairs that are somewhat appressed. Palpi black with black hairs. Clypeus black, with shiny grey pruinosity and long, black, fine hairs; similar hairs in a row emerging from between the eyes.

Thorax: Mesonotum velvety-black, with numerous long, yellow, appressed hairs all along the periphery, and also on the posterior third of the dorsal surface; prescutellar region also clothed with long black hairs; if the light strikes perpendicular to the notum, the anterior border and the prescutellar region appear grey-pruinose. Scutellum black with both appressed yellow hairs and long black hairs, more numerous toward the lateral margins. Pleurae black, evenly grey-pruinose. Postnotum black with patch of tan pruinosity at middle of anterior margin; some specimens show a variable number of long, appressed, yellow scales near the middle of the posterior margin. Halteres with dark brown stem and bright yellow knob. Wings, 3.3 mm. long, without discal cell; costa with both hairs and spines; Sc with about twelve hairs emerging along basal section, the remainder bare; R_1 pilose along distal half; R_{2+3} simple, pilose except for small basal region; Cu_2 arcuate.

Legs: Leg 1—Length, 2.8 mm.; coxa and trochanter yellow; femur yellow with very small black apical ring; tibia black on dorsal edge and at apex, the rest covered with a white bloom; tarsus completely black. Coxa, femur, and tibia with both black hairs and appressed pale yellow hairs; tarsus with short black hairs only. Leg 2—Length, 2.5 mm.; coxa dark brown with all hairs black; trochanter with basal half yellow and apical half black; femur, tibia, and tarsus with same color patterns and similar investiture of hairs as on leg 1. Leg 3—Length, 3.5 mm.; coxa black, trochanter yellow; femur colored as on legs 1 and 2; tibia spindle-shaped with apical two-thirds black, clothed with numerous thick black hairs, the rest yellow; tarsus black, except for the basal third of the basitarsus and basal quarter of second tarsal segment, which are yellow; basitarsus greatly expanded; calcipala and pedisulcus well developed, the latter being very close to the base of the second tarsal segment.

Abdomen: Tergites of all segments velvety-black except for anterior margin of second segment which is grey-pruinose. All segments clothed with short black hairs. Tufts of long black hairs projecting laterally

from the pleural regions of the second through fourth segments; pleura of first segment with backward-projecting fringe of similar hairs along its posterior margin; patch of silvery-white pruinosity present on pleural regions of the second segment and on the fifth through eighth segments. Sternites grey-pruinose on their mid-regions and somewhat tan-pruinose on their sides. Ideotypes: Two males (8X–6, 9) in collection of author.

Simulium (Hearlea) ethelae Dalmat, 1950

This species was originally described (3) from naturally-emerged females and from males which had not emerged, but were dissected from their pupal cases. Numerous pupae have since been collected and reared, and a corrected and amplified description of the male follows.

Male.—2.7 mm. long.

Head: Eyes holoptic, dark reddish-brown. Antennae with eleven segments, the first two light brown, the others black; first two segments with numerous short, stout, black hairs on their upper surfaces, giving the surfaces the appearance of being black. Palpi black with black hairs. Clypeus black with shiny grey pruinosity and long black hairs. Similar long hairs found in the frontal area between the two compound eyes.

Thorax: Mesonotum velvety-black with numerous golden-yellow, narrow, appressed hairs distributed thoughout, somewhat more concentrated around the periphery. In some specimens these hairs are much sparser in the central dorsal region. Prescutellar region bearing numerous long black hairs; with the light striking perpendicular to the thorax, the prescutellar region appears grey-pruinose. Scutellum black with numerous golden-yellow hairs and with long black hairs, both kinds emerging more abundantly from the lateral margins and inclining toward the mid-region; a greyish bloom appears to cover the scutellum when the light strikes it at a 90° angle. Postnotum black with greyish-white pruinosity; without hairs or scales. Pleura black, evenly grey-pruinose. Halteres with stem dark brown; the knob varying from pale to brilliant yellow. Wings, 3.3 mm. long and 1.3 mm. at widest point; costa with both hairs and spines; Sc pilose along basal fifth of its length; R_1 pilose along its distal half only; R_{2+3} simple, pilose except for small basal section; Cu_2 arcuate; discal cell absent.

Legs: Leg 1—Length, 3.1 mm.; coxa and trochanter yellow, clothed with numerous, somewhat appressed golden-yellow hairs; femur yellow with small apical black ring, clothed with both golden-yellow hairs and long black ones; tibia with a complete black ring around its apical fourth and with most of its inner face black, the outer face silvery-pruinose with short silvery hairs; tarsus completely black. Leg 2—Length, 2.8 mm.; coxa black, trochanter yellow with its apex somewhat darker; femur and tibia as on leg 1; tarsus black except for basal half of basitarsus which is yellow. Leg 3—Length, 3.4 mm.; coxa black, trochanter yellow; femur as on leg 2; tibia black except on its basal fourth, and along the basal three-fourths of its inner edge, where it is yellow; tarsus black, with the exception of the basal half of the basitarsus and basal third of the second tarsal segment, which are yellow; tibia

and basitarsus greatly expanded; calcipala well-developed, almost reaching the pedisulcus; pedisulcus present, although not deeply incised; claw simple.

In the original description of the legs of the male, it was incorrectly stated that the pedisulcus was absent, that the base of the second tarsal segment was dilated, and that a minute sub-basal tooth was present on the claw. After studying naturally-emerged males, it is seen that there is no real dilatation of the basal region of the second tarsal segment; the incision of the pedisulcus, although small, apparently caused the neighboring region to appear somewhat inflated. The terminal claw has also been found to be simple.

Abdomen: General black basic color. Second segment with the anterior margin of the tergite, and the lateral regions contiguous to it, grey-pruinose; posterior margins of segments three through eight dull grey. Pleural regions of segments five, six, and seven with patch of silvery-white pruinosity. Rear margin of segment one with fringe of long, black, posteriorly-directed hairs. Extending laterally from each of the pleurites of segments two through five is a tuft of black hairs, shorter than those on segment one. All tergites clothed with very short black hairs, evenly distributed throughout. Sternites all light tan-pruinose.

Ideotypes: Two males (9T–3, 4), in collection of author.

Simulium (Hearlea) delatorrei Dalmat

Simulium (*Dyarella*) *delatorrei* Dalmat, 1950. New species of Simuliidae (Diptera) from Guatemala—2. Ann. Ent. Soc. Amer. 43(1): 137–151.

This species was incorrectly placed in the subgenus *Dyarella* in the original description (3). The form of the male and female genitalia and of the pupal respiratory apparatus, and the clearly-marked pseudo-articulations of the larval antennae indicate that the species actually belongs in the subgenus *Hearlea*.

SPECIES OF FAMILY SIMULIIDAE REPORTED FROM GUATEMALA

In the valuable work of Vargas, 1945 (13), nine species of Simuliidae are listed as having been found in Guatemala up to that year. These are: *Simulium* (*Lanea*) *callidum* D. & S., 1927, *S.* (*Notolepria*) *exiguum* Roubaud, 1906, *S.* (*Simulium*) *metallicum* Bellardi, 1859, *S.* (*L.*) *haematopotum* Malloch, 1914, *S.* (*S.*) *ochraceum* Walker, 1861, *S.* (*Dyarella*) *mexicanum* Bellardi, 1862, *S.* (*D.*) *pulverulentum* Knab, 1914, *S.* (*D.*) *virgatum* Coquillet, 1903, and *Cnephia roblesi* (de León, 1943), n. comb. Of this group, the species referred to as *virgatum* Coq. probably represents what the present author calls *rubicundulum* Knab.

De León, in 1944 (6), described nine new species from Guatemala: *pacheco-lunai*, *tricornis*, *vargasi*, *diazi*, *capricornis*, *aquamarensis*, *carolinae*, *guatemalensis*, and *boydi*. All of these species were placed in the genus *Simulium* by de León, but in the present work *pacheco-lunai* has been transferred to the genus *Cnephia* and *aquamarensis* to *Gigantodax*. Of this group Vargas has shown three to be synonyms: *S. vargasi* was placed in synonymy with *Gigantodax wrighti* Vargas (14); *S. diazi* with *S.* (*E.*) *aureum* Fries (14); and *S. guatemalensis* with *S.* (*S.*) *jacumbae* D. & S. (15). The present author, in comparing specimens of *S.* (*L.*) *boydi* de León, collected at the type locality, with

S. (*L.*) ***haematopotum*** Malloch (8), found the two species identical. Vargas, to whom the author sent specimens of ***boydi***, also concurred with this finding. Since ***haematopotum*** has priority, ***boydi*** de León falls into synonymy.

In 1948, de León (7) brought the total number of species reported from Guatemala up to eighteen by describing the new species, *S.* (*Hearlea*) ***larvispinosum***.

During the period 1948–1949, the writer found eighteen additional species to exist in Guatemala, nine of which have been described as new (2, 3, and present paper). This brings the total for the country to thirty-six. There follow two lists: One consisting of the species found in Guatemala with the Department in which they were collected; the other consisting of the Departments with the species found in each. The distribution data recorded below has been derived from the author's personal collections unless otherwise credited.

DEPARTMENTAL DISTRIBUTION ACCORDING TO SPECIES

S. (*D.*) ***acatenangoensis***, new species
Chimaltenango, Huehuetenango, Jutiapa, Quiché, Sacatepéquez, Santa Rose.

Cnephia aguirreri (Dalmat, 1949), n. comb.
Chimaltenango.

Gigantodax (*G.*) ***aquamarensis*** (de León, 1944), n. comb.
Quezaltenango.

S. (*E.*) ***aureum*** Fries, 1824
Chimaltenango, Huehuetenango, Quezaltenango, Quiché, San Marcos, Sololá, Totonicapán.

S. (*H.*) ***burchi***, new species
Huehuetenango, Quiché.

S. (*L.*) ***callidum*** Dyar & Shannon, 1927
Alta Verapaz, Baja Verapaz, Chimaltenango, Chiquimula, Escuintla, Guatemala, Huehuetenango, Progreso, Quezaltenango, Quiché, Retalhuleu, San Marcos, Santa Rosa, Sololá, Suchitepéquez, Zacapa.

S. (*H.*) ***capricornis*** de León, 1944
Alta Verapaz, Chimaltenango, Huehuetenango, Quiché, Sacatepéquez, Sololá, Totonicapán.

S. (*H.*) ***carolinae*** de León, 1944.
Chimaltenango, Guatemala, Sololá, Suchitepéquez.

S. (*D.*) ***delatorrei*** Dalmat, 1950
Chimaltenango, Huehuetenango, Quiché, Sololá, Totonicapán.

S. (*L.*) ***downsi*** Vargas, Martínez & Díaz, 1946
Alta Verapaz, Baja Verapaz, Chimaltenango, Escuintla, Guatemala, Huehuetenango, Jalapa, Jutiapa, Retalhuleu, San Marcos, Zacapa.

S. (*L.*) ***dugesi*** Vargas, Martínez & Díaz, 1946
Escuintla, San Marcos.

S. (*D.*) ***earlei*** Vargas, Martínez & Díaz, 1946
Chimaltenango, Jutiapa, Progreso, Santa Rosa, Suchitepéquez.

S. (*H.*) ***ethelae*** Dalmat, 1950
Chimaltenango, Guatemala, Huehuetenango, Quezaltenango, Sololá.

S. (*N.*) ***exiguum*** Roubaud, 1906
Alta Verapaz, Chimaltenango, Chiquimula, Escuintla, Guatemala, Huehuetenango, Izabal, Jutiapa, Quiché, San Marcos, Santa Rosa, Suchitepéquez, Zacapa.

S. (*L.*) ***haematopotum*** Malloch, 1914
Alta Verapaz (D. & S., 1927), Chimaltenango, Chiquimula, Escuintla, Huehuetenango, Izabal, Progreso, Santa Rosa, Zacapa.

S. (*S.*) ***jacumbae*** Dyar and Shannon, 1927
Baja Verapaz, Chimaltenango, Guatemala, Jalapa, Progreso, Quezaltenango, Sololá.

S. (*S.*) ***jobbinsi*** Vargas, Martínez & Díaz, 1946
Alta Verapaz, Baja Verapaz, Chimaltenango, Guatemala, Huehuetenango, Quezaltenango, San Marcos, Sololá, Suchitepéquez, Totonicapán.

S. (*S.*) ***kompi***, new species
Chimaltenango.
S. (*H.*) ***larvispinosum*** de León, 1948
Chimaltenango, Suchitepéquez.
S. (*D.*) ***mathesoni*** Vargas, 1943
Chimaltenango, Santa Rosa, Totonicapán.
S. (*S.*) ***metallicum*** Bellardi, 1859
Alta Verapaz, Baja Verapaz, Chimaltenango, Chiquimula, Escuintla, Guatemala, Huehuetenango, Izabal, Jalapa, Jutiapa, Petén, Progreso, Quezaltenango, Retalhuleu, San Marcos, Santa Rosa, Sololá, Totonicapán.
S. (*D.*) ***mexicanum*** Bellardi, 1862
Alta Verapaz (Malloch, 1914), Chimaltenango, Chiquimula (de León, 1943), Escuintla, Guatemala, Huehuetenango, Izabal (Malloch, 1914), Quezaltenango, Suchitepéquez, Zacapa.
S. (*S.*) ***microbranchium*** Dalmat, 1949
Huehuetenango, Quezaltenango, Quiché, Sololá, Totonicapán.
S. (*H.*) ***nigricornis*** Dalmat, 1950
Chimaltenango.
S. (*S.*) ***ochraceum*** Walker, 1861
Alta Verapaz (de León, 1943), Chimaltenango, Chiquimula, Escuintla, Huehuetenango, Jalapa, Petén, Progreso, Quezaltenango, Quiché, Retalhuleu, San Marcos, Santa Rosa, Sololá, Suchitepéquez.
Cnephia pacheco-lunai (de León, 1944), n. comb.
Chimaltenango, Sololá.
S. (*S.*) ***parrai*** Vargas, Martínez & Díaz, 1946
Chimaltenango, Sololá.
S. (*D.*) ***pulverulentum*** Knab, 1914
Chimaltenango, Escuintla, Huehuetenango, Izabal, Jutiapa, Progreso, San Marcos, Santa Rosa, Sololá, Suchitepéquez, Zacapa, (Santa Ana in the Republic of El Salvador).
Cnephia roblesi (de León, 1943), n. comb.
Sololá.
S. (*D.*) ***rubicundulum*** Knab, 1914
Baja Verapaz, Chimaltenango, Chiquimula, Escuintla, Guatemala, Huehuetenango, Jutiapa, Progreso, Quezaltenango, Quiché, Santa Rosa, Sololá, Suchitepéquez, Totonicapán.
S. (*S.*) ***samboni*** Jennings, 1915
Petén, San Marcos, Santa Rosa, Sololá, Totonicapán.
S. (*D.*) ***smarti*** Vargas, 1946
Chimaltenango, Huehuetenango, Sololá, Suchitepéquez.
S. (*S.*) ***tricornis*** de León, 1944
Chimaltenango, Huehuetenango, San Marcos, Sololá, Totonicapán.
S. (*L.*) ***veracruzanum*** Vargas, Martínez & Díaz, 1946
Alta Verapaz, Baja Verapaz, Chimaltenango, Escuintla, Guatemala, Huehuetenango, Quezaltenango, Quiché, San Marcos, Santa Rosa, Sololá, Totonicapán, Zacápa.
Gigantodax (*G.*) ***wrighti*** Vargas, Martínez & Díaz, 1946
Chimaltenango, San Marcos, Sololá, Totonicapán.
S. (*D.*) ***yepocapense*** Dalmat, 1949
Chimaltenango, Huehuetenango, Quiché, Suchitepéquez.

SPECIES DISTRIBUTION ACCORDING TO DEPARTMENTS

CENTRAL ZONE

1. Department of Chimaltenango
   acatenangoensis
   aguirrei
   aureum
   callidum
   capricornis
   carolinae
   delatorrei
   downsi
   earlei
   ethelae
   exiguum
   haematopotum
   jacumbae
   jobbinsi
   kompi
   larvispinosum
   mathesoni
   metallicum
   mexicanum
   nigricornis
   ochraceum
   pacheco-lunai
   parrai
   pulverulentum

rubicundulum
smarti
tricornis
veracruzanum
wrighti
yepocapense

2. Department of Guatemala
callidum
capricornis
carolinae
downsi
ethelae
exiguum
jacumbae
jobbinsi
metallicum
mexicanum
ochraceum
rubicundulum
tricornis
veracruzanum

3. Department of Sacatepéquez
acatenangoensis
callidum
capricornis
exiguum
metallicum
veracruzanum

SOUTHERN ZONE

4. Department of Escuintla
callidum
downsi
dugesi
earlei
exiguum
haematopotum
metallicum
mexicanum
ochraceum
pulverulentum
rubicundulum
veracruzanum

5. Department of Santa Rosa
acatenangoensis
callidum
downsi
earlei
exiguum
haematopotum
mathesoni
metallicum
ochraceum
pulverulentum
rubicundulum
samboni
veracruzanum

NORTHERN ZONE

6. Department of Alta Verapaz
callidum
capricornis
downsi
exiguum
haematopotum (Reported by Dyar and Shannon, 1927)
jobbinsi
metallicum
mexicanum (Reported by Malloch, 1914)
ochraceum (Reported by de León, 1943)
veracruzanum

7. Department of Baja Verapaz
callidum
downsi
jacumbae
jobbinsi
metallicum
ochraceum
rubicundulum
veracruzanum

8. Department of Izabal
exiguum
haematopotum
pulverulentum
metallicum
mexicanum (Reported by Malloch, 1914)

9. Department of El Petén
downsi
metallicum
ochraceum
samboni

10. Department of Huehuetenango
acatenangoensis
aureum
burchi
callidum
capricornis
delatorrei
downsi
ethelae
exiguum
haematopotum
jobbinsi
metallicum
mexicanum
microbranchium
ochraceum
pulverulentum
rubicundulum
smarti
tricornis
veracruzanum
yepocapense

11. Department of Quiché
acatenangoensis
aureum
burchi
callidum
capricornis
delatorrei
exiguum
metallicum
microbranchium

ochraceum
rubicundulum
veracruzanum
yepocapense

EASTERN ZONE

12. Department of Chiquimula
callidum
exiguum
haematopotum
metallicum
mexicanum (Reported by de León, 1943)
ochraceum
rubicundulum
13. Department of Jalapa
downsi
jacumbae
metallicum
ochraceum
14. Department of Jutiapa
acatenangoensis
downsi
earlei
exiguum
metallicum
pulverulentum
rubicundulum
15. Department of El Progreso
callidum
earlei
haematopotum
jacumbae
metallicum
ochraceum
pulverulentum
rubicundulum
16. Department of Zacapa
callidum
downsi
exiguum
haematopotum
mexicanum
pulverulentum
veracruzanum

WESTERN ZONE

17. Department of Quezaltenango
aquamarensis
aureum
callidum
jacumbae
jobbinsi
metallicum
mexicanum
microbranchium
rubicundulum
veracruzanum
18. Department of Retalhuleu
callidum
downsi
metallicum
ochraceum
19. Department of San Marcos
aureum
callidum
downsi
dugesi
exiguum
jobbinsi
metallicum
ochraceum
pulverulentum
samboni
tricornis
veracruzanum
wrighti
20. Department of Sololá
aureum
callidum
capricornis
carolinae
delatorrei
downsi
ethelae
jacumbae
jobbinsi
larvispinosum
metallicum
microbranchium
ochraceum
pacheco-lunai
parrai
pulverulentum
roblesi
rubicundulum
samboni
smarti
tricornis
veracruzanum
21. Department of Suchitepéquez
callidum
carolinae
downsi
earlei
exiguum
jobbinsi
larvispinosum
metallicum
mexicanum
ochraceum
pulverulentum
rubicundulum
smarti
yepocapense
22. Department of Totonicapán
aureum
capricornis
delatorrei
jobbinsi
mathesoni
microbranchium
rubicundulum
samboni
tricornis
veracruzanum
wrighti

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ROCKY MOUNTAIN NATURALISTS, by JOSEPH EWAN. xv+358 pages, 9 plates (portraits). University of Denver Press. 1950. Price $5.00.

The author, a plant taxonomist who lived and worked in Colorado long enough to be considered one of the Rocky Mountain Naturalists of whom he writes, has produced a book which is pleasantly readable, informative, and of especial interest because of the considerable amount of material, either previously unrecorded or recorded in publications of non-permanent nature, which it will preserve for future generations. The first part of the book deals in detail with nine men, including the entomologist-naturalist T. D. A. Cockerell. The account of Professor Cockerell, illustrated by a rare photograph taken with his son, Martin, is very sympathetic and is, perhaps, the most interestingly written part of the book. The description of the "sanctum sanctorum," with its orderly disorder and the background of the foothills, is definitely nostalgic to one who has known it and who has worked with its occupant.

Other sketches of the first part of the book are concerned with the Swiss protozoologist, Eugene Penard, and with seven early Rocky Mountain plant explorers. The second part is a roster, in documented biographical dictionary form, of 798 natural history collectors. The biographies are brief, but with the documentation additional information can easily be found concerning the better-known individuals, and the inclusion of more information, in some cases all that is available of less-known individuals, is definitely advantageous. We might offer in way of criticism, the suggestions that certain outstanding men (for example, Clarence Preston Gillette) should have received the more complete treatment of part one; that documentation of the brief biographies might have been more extensive; and that certain errors and omissions might have been avoided, had the author consulted more of the living persons included (his list of acknowledgments does, however, cover three pages). In all, the work is a fine contribution to the biography of natural history, and the amount of entomological material included should recommend it to the entomologist.—M.T.J.

LOCI OF SENSORY END-ORGANS USED BY MOSQUITOES (AEDES AEGYPTI (L.) AND ANOPHELES QUADRIMACULATUS SAY) IN RECEIVING HOST STIMULI

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During the recent war intensive investigations on mosquito repellents were carried out in various countries. Much of this research involved testing large numbers of chemical compounds as possible repellents for protecting troops in mosquito-infested areas (Christophers, 1947; McCullogh and Waterhouse, 1947; Travis *et al.*, 1949). However, interest in the fundamental problem of the nature of the stimuli which attract mosquitoes to their hosts was revived (*e.g.*, Willis, 1947; Parker, 1948) and the results of these and other workers have shown that moisture, temperature, to some extent body odor, and carbon dioxide (for at least one species of *Anopheles;* van Thiel, 1947), are factors in attracting mosquitoes. Most of the evidence to date indicates that the olfactory organs of insects are located in the antennae (see reviews by Marshall, 1935, Wigglesworth, 1939, Dethier and Chadwick, 1948). Bates (1949) in reviewing the food habits of adult mosquitoes stated that the ability to orient to odors by means of the antennae ". . . is shared by so many different insects that it can safely be assumed to exist in mosquitoes even though in this particular case direct experimental evidence is lacking." The following work was done to add to our knowledge of mosquito behavior by determining the sensory end-organs of *A. aegypti* (L.) and *A. quadrimaculatus* Say which receive host stimuli.

EXPERIMENTAL METHODS

The following experiments involved the study of the behavior of female mosquitoes which had various sense organs removed. The mosquitoes were fed on water and honey solution and none had a blood meal prior to testing. Operations were performed with microdissecting scissors, on mosquitoes kept under carbon dioxide anesthesia in the manner described by Roth (1948). The individual operations are performed in only a few seconds but females can be kept under continuous anesthesia for as long as 60 minutes without affecting their feeding behavior after recovery. Two hours of continuous anesthesia may result in high mortality of the test insects. The ages of *A. aegypti* used ranged from 4 to 11 days and those of *A. quadrimaculatus* were 5 to 14 days old. Unless otherwise stated all experimental and control insects were placed in cages 11″ x 11″ x 15″ and at various intervals after their recovery from anesthesia their responses (*i.e.*, attraction, probing, feeding) to the human arm and hand, and temperature alone, were observed.

EXPERIMENTS ON AEDES AEGYPTI

Experiment 1. To determine if the eyes are necessary for the female to locate its host.

The eyes of 30 females were covered with a layer of shellac rendered opaque with carbon black. The shellac was applied with a micropipette. In most cases the shellac also, unavoidably, covered the pedicelli of the antennae and the palpi (often cementing the palpi to the base of the labial theca).

Generally these "blind" mosquitoes were not as active nor as readily disturbed as normals. However, in subsequent tests practically all were activated to flight, within 3 minutes, and readily found the arm when it was introduced into the cage. In several exposures, although many probed, only 4 were capable of taking blood. It was found that these 4 mosquitoes had little or no shellac at the base of the labium and their palpi were not cemented to the labium. On the contrary, practically all the females which probed but could not pierce the skin had their palpi cemented to the labium. This prevented the labium from being "kinked" during probing, so that the tips of the stylets could not be inserted into the skin. This was shown to be the case when shellac was applied to 13 other females, cementing their palpi to the base of the labium (eyes not covered). Though all probed readily, none were capable of taking blood. Shellac placed on the ventral surface of the labium near its base did not prevent feeding as long as the theca was not united to the base of the stylets and was capable of being bent under the head.

Conclusion: The eyes are not necessary, in a small area such as a cage, in locating the host.

Experiment 2. To determine the role of the antennae in locating the host and probing.

A. When the arm is placed in a large celluloid cylinder (20″ long x 6″ wide) with a cheesecloth barrier at one end, and the tube is introduced into a cage containing *A. aegypti* females, the mosquitoes are activated to flight, are attracted by the arm in the cylinder, and may fly down the tube to rest and probe through the cheesecloth barrier which is being held in place by the hand of the observer (Fig. 1). To determine if individuals without antennae would react in a similar manner, the following experiment was performed.

Twelve flagellar segments from both antennae were removed from 80 females. Twelve flagellar segments from one antenna from each of 80 females were removed (40 with the right and 40 with the left antenna missing to the first flagellar segment). Eighty controls with both antennae intact plus the 160 experimentals (a total of 240 mosquitoes) were placed in one cage. After 18 hours, 6 females lacking both antennae and 4 females with one antenna missing were dead or unable to fly, and these were discarded. The celluloid cylinder was then introduced to determine the response of the mosquitoes. Three 3-minute trials were made. None of the 74 females lacking both antennae were recovered in the cylinder; twenty-two (29%) of those lacking one antenna came down the tube (9 with the right and 13 with the left flagellar segments removed); seventy-one (89%) controls came down the cylinder to probe through the cheesecloth. The mosquitoes which came down the cylinder were removed from the cage.

Six hours later the celluloid cylinder was again introduced into the cage. However, this time a rabbit was placed against the cylinder outside the cage. Eight mosquitoes came down to feed and all of these were normal controls. Thus 99% of the controls were attracted to man and rabbit. Twenty-nine percent of the females with one antenna missing were attracted to man while no mosquitoes with both antennae missing to the first flagellar segment were attracted into the cylinder.

The operated mosquitoes were placed in 5″ x 6″ circular, wire-screen cages and their feeding response was tested on the arm. Again it was found that in general mosquitoes lacking 12 flagellar segments from both antennae were not attracted to man, but if the cage was placed so that

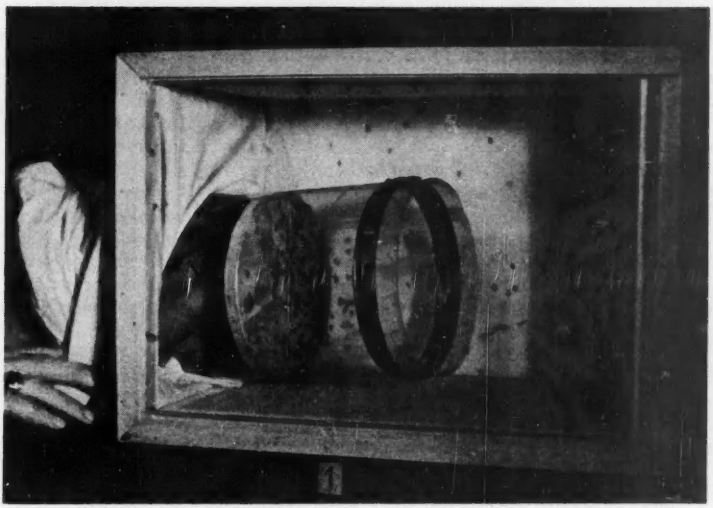


FIG. 1. *Aedes aegypti* females attracted to the human arm and hand. The celluloid cylinder was originally designed by Dr. Edwin R. Willis, Dr. Ralph C. Davidson, and Mr. Robert L. Peffley, of The Ohio State University, to isolate females which are attracted to man and presumably would take a blood meal.

the females rested directly above the skin (separated from it by the wire screen), some eventually probed and fed. If feeding was interrupted and the cage moved, the females probed haphazardly. If by chance they came to rest on the portion of the screen next to the arm, they would proceed to feed. Those females with one antenna missing were capable of finding the arm and feeding.

B. One of the most characteristic responses of *A. aegypti* females to man is obtained when the arm is introduced into a cage containing these insects. Almost immediately the females are activated to flight, quickly settle on the skin and feed (Fig. 2). The indifference of mosquitoes lacking the flagellar segments of the antennae was again clearly shown

in the following experiment. The flagellar segments from both antennae were removed from 50 females, one antenna from 50 others, and 50 unoperated insects were used as controls. These 3 groups were placed in 3 different cages. Twenty-two hours later the mosquitoes were tested by placing the arm within each cage for a period of 3 minutes; none of the 49 mosquitoes (one dead) lacking both antennae responded (Fig. 3); 45 out of 48 (two dead) females lacking the flagellar segments from one antenna landed and fed; 50 controls were attracted and fed. Both the controls and those lacking one antenna were discarded. The females lacking the flagellar segments from both antennae were kept and tested at various intervals with the following results:

After 30 hours the arm was introduced into the cage. During the 3-minute exposure 3 or 4 mosquitoes began to fly about. One landed on the arm but neither probed nor fed.

At the 44-hour trial, one landed on the finger and fed during a 3-minute exposure. There was no direct flight to the arm, the mosquito apparently landing by chance. Two or three mosquitoes flew aimlessly about, the others remaining quiescent.

At the 51-hour trial period several females flew about the cage, but none landed on the arm. Two females were seen to probe the cloth mesh of the cage. The arm was kept in the cage, and some of the mosquitoes were made to walk on the skin. In a one-half-hour exposure, 7 females fed to repletion, while at least that many remained indifferent, though resting on the skin. Further tests were made at 68, 79, 91, and 108-hour intervals. None of the mosquitoes were attracted to the arm. At the 91-hour trial, 2 females fed during a one-half-hour exposure, when placed directly on the skin. However, others remained indifferent even though they rested on the skin.

C. The flagellar segments of both antennae from 64 females were removed, and the remaining stumps were covered with shellac (applied with a micropipette). It was assumed that this operation completely eliminated the functioning of the antennae. In covering the antennal remains, parts of the eyes were unavoidably covered with shellac.

The arm and hand was exposed to the mosquitoes for six 10-minute trials at 16, 24, 42, 48, 70, and 90 hours after the operations. During these exposures only 5 females landed on the arm and fed. There was no direct flight to the arm. During some of the trials several mosquitoes would land on the arm and rest without feeding, or fly away after a short time.

The flagellar segments of both antennae from 50 females were removed as close to the pedicelli as possible, usually leaving only small stumps of the first flagellar segments protruding slightly beyond the margins of the pedicelli. At various intervals the arm was introduced into the cage (usually one-half-hour exposures), and the mosquitoes were disturbed and made to land on the skin to test their feeding response.

At 17 hours (after the operations) 1 fed; 20-hour trial, 7 fed; 34-hour trial, 10 fed; 39-hours, 7 fed; 60 hours (1 dead), 7 fed; 116 hours, 4 fed. Of a total of 48 (2 dead at the first trial) experimental females, 36 (75%) fed when made to land or placed directly on the skin. Six tests were made, the mosquitoes being exposed to the arm for a total of 3 hours. Eleven females failed to feed. Generally, those females that fed often

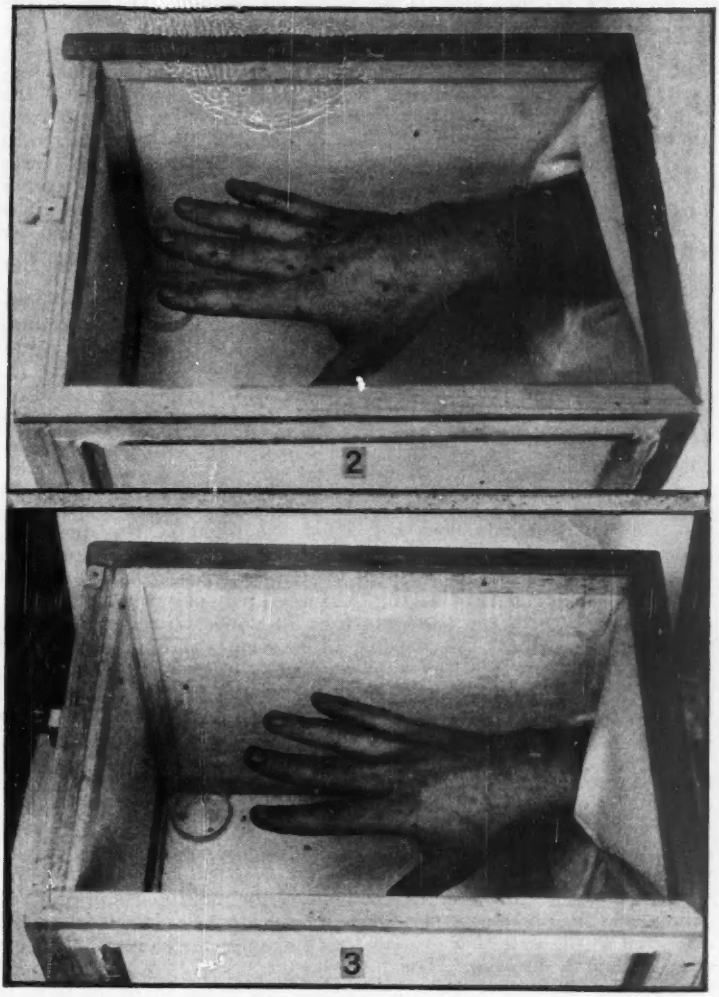


FIG. 2. Cage containing 100 normal females of *Aedes aegypti* showing the 100 percent feeding response elicited within three minutes after the hand is introduced into the cage (some females are feeding on the undersurface of the arm and hand; females resting on the sides of the cage have already fed).

FIG. 3. Cage containing 50 antennectomized females of *Aedes aegypti* showing the lack of response to the hand.

probed a few minutes after being placed on the skin. However, the probing time was variable and some took longer than others.

Those females which fed were removed and checked under a dissecting microscope to see how much of the first flagellar antennal segment remained. Although the length varied somewhat with the individuals, usually all had only small stumps protruding a little beyond the margins of the pedicelli. Sixteen of these females were cleared in KOH, mounted in chloral gum and examined under the high power of a compound microscope. The remaining stumps of the first flagellar segments bore only minute spicules, a few scales and sometimes a few small setae. None of the specimens had any of the sensilla which are restricted to about the apical two-thirds of the first flagellar segment, and numerous over the surface of the other flagellar segments.

The flagellar antennal segments from 35 females were removed close to the pedicelli and the remaining portions (scapes, pedicelli and stumps of the first flagellar segments) were covered with shellac. The arm was introduced into the cage 8 different times at 24, 30, 43, 48, 52, 69, 78, and 93 hours after the operations. Most of the exposures lasted 30 minutes with a total exposure time of about 3½ hours. The mosquitoes were disturbed and made to land on the skin. A total of 22 (63%) mosquitoes fed.

Conclusions: The removal of the flagellar segments from one or both antennae leaving only the scapes, pedicelli and small stumps of the first flagellar segments does not affect the flight of the mosquito, although those with the flagellar segments of both antennae removed are not as active as normal females; the bilaterally flagellectomized females tend to rest on the sides of the cage and usually fly only when disturbed.

Mosquitoes with the segments from one antenna removed to the first flagellar segment are capable of locating the human arm and feeding. However, from the small number of females, as compared to normals, coming down the cylinder, it is probable that they have some difficulty orienting themselves when a barrier (*i.e.*, celluloid cylinder) is introduced.

Females, the antennae of which have been completely removed, remain more or less quiescent and are not attracted from a distance by stimuli (from the arm and hand) which activate normal individuals. However, these females may feed when placed directly on the skin, indicating that another organ(s) is involved in receiving the stimuli which induce probing.

Experiment 3. To determine the role of the mouthparts in probing.

Since in the previous experiments antennectomized females were not attracted to the arm, it is evident that the antennae alone receive host stimuli from a distance. The following experiments were performed to determine the role of the mouthparts in the induction of the probing response.

A. *Palpi:* The terminal palpal segments (or more) from both palpi of 50 females were removed. The palpal sense organs, somewhat similar (externally) to the sensilla on the antennae, are found on the fourth or last segments in this species.

After 9 hours the arm was introduced into the cage for 3 minutes. Thirty females fed. Thirty-three out of 35 normal controls fed. After 11½ hours, the arm was again introduced into the experimental cage

and 12 more mosquitoes fed in 3 minutes. A total of 42 of the 50 females lacking at least the terminal palpal segments were attracted to the arm and took a blood meal. Seven failed to feed while one died during the experiment.

B. *Labellum:* By cutting just above the base of the labellum this structure was removed from 50 females. The tips of the stylets were also removed in this operation. The arm was introduced into the cage at 3 different intervals after the operation, for 3-minute exposures. During the 11-hour trial, 24 females landed and probed (2, 3-minute exposures); after 22 hours, 9 came to the skin and probed. A total of 33 (66%) females lacking the labellum probed but were unable to pierce the skin.

C. *Stylets (labrum, mandibles, hypopharynx, and maxillae)*: When mosquitoes are anesthetized with carbon dioxide, some individuals will have the labium kinked or bent so that the compact bundle of stylets is exposed near the clypeus. It is a simple matter to sever these structures at the point of exposure. The stylets may then be removed by grasping the free ends with forceps and pulling out the bundle so that it slides through the labial gutter, or the severed bundle (now non-functional) may be left in the labial gutter.

The above operation was performed on 25 females. After 5 hours the arm was introduced into the cage. Eighteen females landed and probed during the 3-minute exposure, the proboscis merely bending when pressed into the skin. The arm was again introduced into the cage and the remaining 7 mosquitoes disturbed. Five more landed and probed. A total of 23 (92%) females with the stylets removed or severed, probed the skin.

D. *Labium:* The labium from each of the 25 females used in C (already lacking the stylets) was removed, the cut being made in the region under the palpi.

The arm was introduced into the cage for a 5-minute exposure, 15 hours after the operation. At this time 3 females had died. Thirteen females, having only antennae and palpi landed and probed. The probing response of a female lacking the proboscis consisted of walking over the skin surface and stopping now and then to move the head up and down. Some pushed the head against the skin. The remainder of the mosquitoes were disturbed, and 7 more landed and probed. A total of 20 (91%) females probed; two failed to probe.

E. *Proboscis and Palpi:* Twenty females from Experiment D, which already lacked stylets and labium, had both their palpi and what remained of the base of the labium removed close to the clypeus. The proboscides and palpi were also removed from 19 females used in Experiment B (already lacking the labellum) giving a total of 39 females having only the antennal appendages remaining on the head.

The arm was introduced into the cage at 6½, 12, and 22 hours after the removal of proboscides and palpi. A total of 25 females landed and probed; six failed to probe and 8 died during the experimental period.

Conclusions: Females lacking the terminal palpal segments which bear sensilla organs, are attracted to and will feed on man. The removal of the labellum, stylets, labium, proboscis, and palpi, does not eliminate the probing response.

Experiment 4. To determine the combined role of both antennae and palpi in the induction of probing.

The flagellar segments from both antennae and the terminal palpal segments were removed from 15 females. The mosquitoes were exposed to the arm at 6 different intervals (10, 35, 43, 67, 95, and 106 hours after the operations). Exposures ranged from 10 to 30 minutes with the total exposure amounting to about 2 hours. Only 2 females fed. These were checked closely under high power and one was found to have one entire first antennal flagellar segment. In the other specimen, the first flagellar antennal segments were cut close to the pedicelli and did not include the sensilla found on the apical two-thirds of the segment. In both females the palpi were cut close to the clypeus so that the terminal segments plus their sensilla were lacking.

The experiment was repeated using 40 females. The arm was placed in the cage at 21, 47, 68, 77, and 90 hours after the operation, with exposures ranging from 5 to 30 minutes (total exposure 1½ hours). Only 4 females fed, and upon examination all of these had one or both first antennal flagellar segments intact (but terminal palpal segments missing).

To insure the complete elimination of the antennae and palpi, the experiment was again repeated using 39 females, with 20 of these individuals having the remains of the antennae and palpi covered with shellac; the remaining 19 had the antennae removed and the stumps covered with shellac and with their palpi left intact but covered with shellac. Their response was tested 8 different times at 22, 46, 51, 70, 77, 96, 104, and 122 hours after the operation. Exposures usually lasted about 30 minutes with a total exposure of 3½ hours. Four mosquitoes probed, one of these taking a blood meal; (one probed a warm glass rod; one was seen to probe the small glass water container, and when placed on the hand continued to probe). These mosquitoes were checked under high power and the stumps of both palpi and antennae were well covered with shellac.

In all of these tests the females were placed directly on the skin since, without the antennae, they were not attracted to the arm. The total exposure time for these, previous, and later experiments where the antennae and mouthparts were removed does not mean that each mosquito rested on the skin of the observer that length of time. It represents the length of time spent by the experimenter in trying to induce the mosquitoes to probe.

When placed on the skin of the observer or when a warm glass rod was brought nearby, some of these females showed slight vibratory motions of the proboscis and slight up and down movements of the head, with the proboscis extended forward. In true probing the proboscis is generally brought at right angles to the surface and is pressed into the skin. Some females rubbed their hind legs together, rubbed the wings with their hind legs, or rubbed the proboscis with their front legs when stimulated by the hand or a warm glass rod.

Conclusion: Antennectomy plus palpectomy greatly inhibits the probing response in females and will in almost all cases abolish it completely.

The Temperature Response of Females. It is well known that female

mosquitoes can be attracted and induced to probe by temperature alone (Howlett, 1910; Marchand, 1918; Crumb, 1922). The following experiments were undertaken to determine what structures are involved in the reception of temperature stimuli.

Experiment 5. To determine if antennectomized females will be attracted by temperature alone.

A thermos flask (doublewalled, silvered) with its tip broken and containing water heated to 56°–57° C. was used as the attracting stimulus. With the vacuum broken enough heat escapes through the walls to attract normal females. An empty thermos kept at room temperature does not attract mosquitoes. The thermos had a layer of cheesecloth wrapped around it to give the attracted females a surface on which to land and probe. The flask was placed in a cage of normal females before and after being used in a cage of experimental mosquitoes, in order to check its attractiveness.

Fifty-nine females had their antennae removed close to the pedicelli and the remaining stumps covered with shellac. The thermos was introduced for 10-minute exposures at 25, 43, 48, 71, and 95 hours after the operations. Only 2 females landed on the thermos and probed. Two others landed but failed to probe. In a control experiment using 30 normal females, all were attracted to and probed the thermos during four 10-minute trials.

The experiment was repeated with 28 antennectomized females but the insects were given a choice of two thermos flasks, one filled with hot water and the other empty (control). Six 10-minute trials were made. A total of 6 females landed on the warm thermos (3 probed) and 6 landed on the control flask (none probed). The small number of insects which landed on the warm thermos and the fact that an equal number of insects landed on the control, shows that the antennectomized females were not attracted by temperature.

Experiments were performed to determine the effect of the removal of various numbers of flagellar segments on the attraction of females by temperature. Groups of females lacking different numbers of antennal segments were placed in the same cage and exposed to the warm thermos. Those that landed and probed during the 10-minute trial periods were removed from the cage (with an aspirator) and examined under a binocular microscope to determine the number of flagellar segments remaining on the antennae. In the first experiment 4 groups of mosquitoes were used; these groups and the results of 4 trials are shown below:

Number of Females Used	Number of Antennal Flagellar Segments Present on Each Antenna	Total Number and Percent of Females Landing and Probing During Four Trials
29	3	5 (17%)
28	6	25 (89%)
31	9	31 (100%)
29	13 (control)	29 (100%)

This experiment was repeated using similar groups as above but including females with 0 and 1 flagellar segments. The results were similar and showed that females with 3 or less flagellar segments were little or not at all attracted by temperature while a high percentage of females with 6 or more flagellar segments were attracted by temperature.

Conclusions: Antennectomized females are not attracted by temperature. A high percentage of attraction is obtained from females with 6 to 13 flagellar segments; this percentage is markedly reduced when 10 or more segments are removed.

Experiment 6. To determine if temperature alone will induce antennectomized females to probe.

The previous experiment showed that antennectomized females would not be attracted to a warm thermos, but it was indicated that a female would probe if she happened to land on the thermos. In the following experiment the stimulus consisted of a test tube containing warm water, brought close to the resting female. The tube containing warm water was tested on normal females first to see if it would induce probing, before being used on the antennectomized females. Fifteen females had their flagellar segments removed and their remaining stumps covered with shellac. They were tested at 75, 99, 106, 128, and 147 hours after the operation. Ten (67%) of the females were induced to probe. A total of 1 hour was spent in trying to induce probing.

Conclusion: Temperature alone may induce antennectomized females to probe.

Experiment 7. To determine if temperature alone will induce probing in females lacking antennae and the terminal palpal segments.

Thirty-three females had their antennae removed and the stumps covered with shellac. The terminal palpal segments, or more, were also cut off. The females were tested in the same manner as in the previous experiment. Five trials were made at 14, 24, 55, 64, and 75 hours after the operations. Only one female was induced to probe. This female probed in spite of the absence of the fourth palpal segments (checked under a microscope). A total of 2 hours was spent in trying to induce these females to probe.

Conclusion: Antennectomy plus removal of the terminal palpal segments in practically all cases eliminates the probing response to temperature.

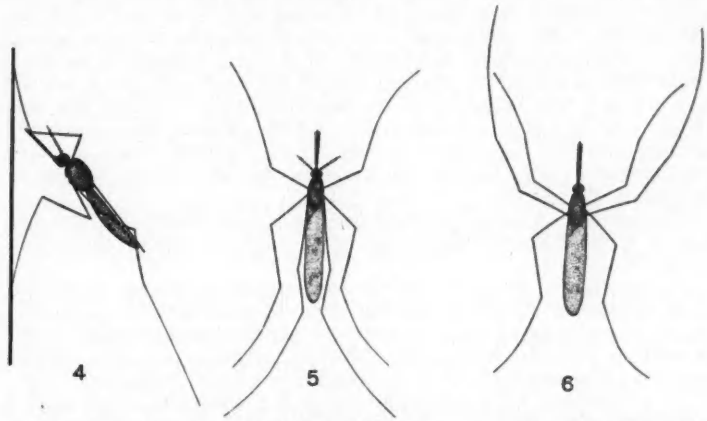
EXPERIMENTS ON ANOPHELES QUADRIMACULATUS

Experiment 8. To determine the role of the antennae in locating the host and probing.

The 13 flagellar segments of both antennae from 50 females were removed close to the pedicelli and the remaining stumps were covered with shellac. The arm was introduced into the cage at 8, 20, 24, 25, 30, and 42 hours after the operations. Exposures ranged from 15 to 45 minutes with a total exposure of 2½ hours. In general the mosquitoes were rather easily disturbed in spite of the absence of antennae. However, they showed no directional response and in most cases were forced to land on the skin, by placing the hand between them and the side of the

cage, where they fed or probed readily. Forty-six of the 50 antennectomized females probed or fed (30 fed; 16 probed) and 4 died during the experiment. Of 20 normal controls, 18 fed in a 2-minute exposure, 7 hours after the start of the experiment.

It was found that some of the females which probed but which did not feed had the base of their palpi cemented for a short distance to the base of the proboscis, by the shellac. In normal probing the palpi are raised (cf. Robinson, 1939), project upward and forward, and vibrate rapidly as the stylets are pushed into the skin. When the palpi are cemented to the proboscis, near its base, they cannot be extended during probing and therefore push against the skin thus preventing the stylets from piercing. It is purely a mechanical barrier,



Diagrams of females *of Anopheles quadrimaculatus* at rest, showing positions of the legs. FIG. 4. Lateral view; normal female. FIG. 5. Dorsal view; normal female. FIG. 6. Dorsal view; antennectomized female. Note the position of the hind legs when the finger of the observer is placed in front of the mosquito.

since females lacking palpi feed readily. Some females appear highly "excited" and, though they probe vigorously, do not feed, although their palpi are free and capable of being raised. Antennectomized females may probe a warm glass rod when brought near the screen on which they are resting.

When an *Anopheles* female is at rest, her proboscis and abdomen are in more or less a straight line. The front and middle pairs of legs touch the surface on which she is resting while her hind legs are extended posteriorly. When not in motion, the femora of the hind legs extend backward with their apices at about the level of, or slightly above the wings; the apices of the tibiae point postero-ventrally beyond and below the level of the abdomen; the tarsi extend laterally and their tips are widely separated away from the mid-body line. Both the hind femora and tibiae are held close to the body (Figs. 4, 5). The hind legs may be held motionless in the above position but more often

they show a definite movement, particularly when the mosquitoes are disturbed. The hind legs may be moved in unison, or as is more often the case, alternately. This motion is more or less a circular one and when the legs move in unison reminds one of a swimmer doing the breast-stroke. The femur is brought upward then forward and back in a rotary motion with the tips of the tarsi often reaching to or beyond the front legs. There may also be short movements with the tips of the tarsi describing an ellipse or a small circle. While feeding, the hind legs may rest on the skin or be held away from the surface. Sometimes, particularly if the female has difficulty piercing, the hind legs will be waved about, repeatedly touching the skin surface.

During the antennal experiments the following interesting observation was made. If the hand or a finger is placed in front of antennectomized females, the hind legs are brought forward and touch the skin (Fig. 6). Some of these females then either probe the area around them or walk to the finger and probe. If the hand is placed behind the female just far enough so that the tips of her hind tarsi can reach the skin, the legs will be extended to their full length to touch the skin surface; the legs may undergo typical rotary motions briefly touching the skin and the mosquito may then probe or walk away. It thus appears that a tactile sense in the hind legs may be involved in inducing probing in this species.

Conclusions: Antennectomized females cannot locate the host, but feed or probe more or less readily when they are placed on or near the skin.

Experiment 9. To determine the role of the mouthparts in probing.

A. *Labellum:* The labellum was removed from each of 15 females. The stylets were first freed from the theca and the labellum was removed by cutting just above its base. After recovery from anesthesia the stylets were re-ensheathed by the front legs of the mosquitoes.

In subsequent tests practically all landed and probed, but only 3 pierced the skin and fed. These were checked under a microscope; in all cases the labellum was completely lacking, and the tips of the stylets protruded from the cut end of the labium.

B. *Palpi:* The palpi were removed close to the clypeus from 20 females. Tested after 11 hours, all landed and probed, 16 feeding within 3 minutes. The remaining 4 females fed during a 3-minute exposure at a second 18-hour trial. These mosquitoes will probe when a warm glass rod is brought near them.

3. *Proboscis and Palpi:* The proboscides and palpi of 30 females were removed close to the clypeus, leaving the antennae as the only remaining head appendages. Two trials were made at 12 and 18 hours after the operations. Most of the females came to the arm readily and probed wildly, pushing the head against the skin.

Conclusions: Females will probe after the removal of the labellum, palpi, and proboscis and palpi.

Experiment 10. To determine the combined role of antennae and palpi in the induction of probing.

The flagellar segments were removed close to the pedicelli and the palpi were cut off close to the clypeus in 50 females. To insure the complete elimination of the function of both antennae and palpi,

the remaining stumps were covered with shellac. In most cases while covering the palpal remains, shellac was also unavoidably applied to the base of the labium, thus preventing feeding, since the theca could not be bent away from the stylets during probing. However, the mosquitoes were only tested for probing and were removed from the cage as soon as they responded. Both the hand and a warm glass rod were used to induce probing, either from the outside (brought up against the screen on which the mosquitoes were resting) or within the cage, the mosquitoes being made to land on the skin or the glass rod brought close to the female.

Three trials were made at 14, 22, and 26 hours after the operations, each exposure lasting 30 minutes. Forty-eight (96%) of the females probed (29 probed when stimulated by the hand and 19 probed a warm glass rod). Many probed after the finger or hand was brought near enough so that the hind legs, in their waving motion, could touch the skin. Some waved the legs and touched the skin several times and then either climbed on to the skin and probed, or probed through the cloth on which they were resting. The warm glass rod induced probing when brought close to the cloth of the cage on which the females were resting. Once induced to probe, some females continued to do so for a short time after the stimulus was removed. These antennectomized and palpectomized females could also be induced to probe by a current of warm air. All mosquitoes were examined after probing to check the completeness of the covering of the antennal and palpal stumps with shellac.

Conclusions: Females will probe readily after antennectomy and palpectomy.

Experiment 11. To determine the behavior of females after the elimination of all the sense organs on the head.

The flagellar segments of both antennae from 24 females were removed close to the pedicelli and their proboscides and palpi were severed close to the clypeus. Two tests were run at 7 and 9 hours after the operation. Five were dead at the first trial and, of the remaining 19, 17 gave the probing response which consisted of distinctly moving the body up and down and pushing the head against the skin or against the screen where the head was held. Two mosquitoes probed after being stimulated by a current of warm air. Most of the others were made to probe by permitting their hind tarsi to touch the skin.

The same operation was performed on 23 females, but in addition the eyes were covered with a thick coat of blackened shellac. The shellac, when applied with a micropipette, formed a large blob and covered not only the eyes, but almost the entire head, reaching to the back margin of the eyes and over the occipital region. The mosquitoes were tested only once, 7 hours after the operation. At this time 9 were dead or unable to walk or fly. Of the others, 8 gave a probing response (2 to a warm glass rod; 6 when stimulated by the hand). Six failed to probe. Though the probing response was distinct, it was usually of short duration.

Conclusion: Probing may be induced in females lacking all of the sense organs found on the head.

DISCUSSION

The present results summarized in Table I show that the antennae of *Aedes aegypti* and *Anopheles quadrimaculatus* possess sense organs which function as receptors for receiving host stimuli from a distance. The results with *A. aegypti* using temperature alone as the stimulus, parallel closely those obtained using the arm and hand to attract females and induce probing. Since in using the arm as a stimulus one is dealing not only with chemical but thermal stimuli as well, it is not possible to conclude that the antennae function as distance chemoreceptors, although this is highly probable. The temperature experiments show that the antennae of *A. aegypti* do function as directional

TABLE I

SUMMARY OF THE BEHAVIOR OF FEMALES OF *Aedes aegypti* AND *Anopheles quadrimaculatus* AFTER THE REMOVAL OF VARIOUS SENSE ORGANS

CONDITION OF FEMALE	BEHAVIOR TO MAN			
	Aedes aegypti		*Anopheles quadrimaculatus*	
	Attraction	Probing	Attraction	Probing
1. *Antennae (mouthparts intact)*				
a. One antenna missing to first flagellar segment	Attracted	Probe	*	
b. Bilateral antennectomy	Not Attracted	Probe	Not Attracted	Probe
2. *Mouthparts (antennae intact)*				
a. Palpectomy	Attracted	Probe	Attracted	Probe
b. Labellectomy	Attracted	Probe	Attracted	Probe
c. Styletectomy	Attracted	Probe	*	
d. Proboscectomy	Attracted	Probe	*	
e. Combined proboscectomy and palpectomy	Attracted	Probe	Attracted	Probe
3. *Mouthparts, antennae*				
a. Combined antennectomy and palpectomy	Not Attracted	Probing abolished in almost all cases	Not Attracted	Probe

* Experiment not performed.

distance thermoreceptors. Combined antennectomy and palpectomy will in practically all cases abolish the probing response in *A. aegypti*. Thus the antennae and palpi are the chief organs used by this mosquito in locating its host and receiving the stimuli which induce probing. The antennae perform both functions while the palpi act as nondirectional receptors receiving stimuli when the insect is on or near the skin of the host.

In the present experiments it was shown that the eyes of *A. aegypti* are not necessary for locating the host. Further evidence for this

is found in the fact that mosquitoes will orient, in a darkened chamber of an olfactometer, to an air stream bearing human body odor (Willis, 1947). It is also known that mosquitoes are capable of finding man in total darkness. However, Kennedy (1939) in a study of the visual responses of *A. aegypti* showed that vision plays an important role in upwind orientation and he believes that this combined with the activating effect of host scent results, in nature, in the insect flying towards the source of stimulation.

The probing response of *A. quadrimaculatus* is much more difficult to eliminate, by removal of various sense organs, than the response of *A. aegypti*. This is interesting in light of the fact that as a rule the effectiveness of a given repellent is lower against this anopheline than the culicine. These two species may react differently to the same repellent. Based on the variation in behavior of the above species DeLong et al (1945) classified various repellents into two major groups, namely, "tactile and olfactory." These workers suggested the possibility that the difference in behavior of the two species to a "tactile-type" repellent might be due to a difference in the sensory end-organs involved in receiving host stimuli. The elimination of palpi and antennae in *A. quadrimaculatus* does not eliminate the probing response. In fact elimination of all of the sensory organs on the head in this species does not necessarily abolish probing. The behavior of *A. quadrimaculatus* indicates that the hind legs of the female may function as sense organs. Whether or not these legs serve as tactile organs (*i.e.*, detect air currents, or convection currents set up by the heat from the arm) or function in some other manner has yet to be determined. Wesenberg-Lund (1921) has suggested that the long outstretched hind legs of *A. maculipennis* ". . . are used as organs of feeling." It is possible that the few cases of probing obtained from *A. aegypti* after removal of the palpi and antennae are also due to some sensory structures in the hind legs. If so it is apparent that this sense is less developed than in *A. quadrimaculatus*.

SUMMARY

1) The antennae and palpi are the chief organs used by *Aedes aegypti* females in locating the host and receiving the stimuli which induce probing. In cages 11″ x 11″ x 15″ the eyes are not necessary to locate the host. The antennae function as directional distance thermoreceptors, and probably chemoreceptors as well. The palpi receive stimuli when the insect is on or near the skin of the host. Temperature receptors in *A. aegypti* females are also found on the palpi. Antennectomized females are not attracted to man, and combined antennectomy and palpectomy in almost all cases will abolish probing.

2) The antennae of *Anopheles quadrimaculatus* females also receive directional host stimuli from a distance. In this species, a high percentage of females probe even after combined antennectomy and palpectomy. The behavior of *A. quadrimaculatus* indicates that the hind legs may function as sense organs (when near the host) possibly in detecting air currents, or convection currents resulting from the warmth of the host.

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THE NATURE OF NATURAL HISTORY, by MARSTON BATES. 309 pages. Charles Scribner's Sons, New York. Price, $3.50.

This interesting book is a demonstration of the fact that the statement of scientific materials needs not be couched in a highly technical language. The non-professional will enjoy the lucid and interesting style in which a survey of the more important biological principles is presented; the professional may find some surprises in the simplicity with which certain difficult theses are explained. The purpose of the book, as the author states, is "not to impress with the facts of biology," but "to arouse interest in an attitude, to explain a point of view, using facts only insofar as they may be necessary as illustrations for this attitude." With this definition, does not natural history again become that of the vanishing race of "old naturalists"? I am not sure but that our present race of specialists might benefit by looking to the past, amalgamating what was best with the increased knowledge of minutiae, and, as teachers, teaching attitudes as well as facts.—M.T.J.

THE GENUS CULICOIDES IN ALASKA

(Diptera, Heleidae)[1]

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During recent years considerable interest has developed in the problem of controlling biting flies in Alaska (Travis, 1949). As a necessary adjunct to control studies, several surveys have been made to determine what species are represented, and during the last three years many data have been accumulated on the habits of the Alaskan species. This taxonomic report on *Culicoides* brings up to date our knowledge of the six known species of the genus in Alaska and makes available names which may be used in reports on biology and control. One of the six species treated here is described as new.

According to Travis (*l.c.*), *Culicoides* are second only to mosquitoes as pests in Alaska. Jenkins (1948) has presented a very good summary of the habits of the adults. The most notorious pest is *C. tristriatulus* Hoffman, whose activities along the coast are described by Jenkins. *C. obsoletus* (Meigen) and *C. yukonensis* Hoffman are the most abundant and widely distributed species, the former predominantly coastal and the latter most frequently encountered in the interior. The other known species are rare. During 1948 and 1949 the breeding habits and immature stages of several of the species were discovered and will be reported by other workers.

The material recorded here, unless otherwise noted, is in the U. S. National Museum and was obtained by the Alaska Insect Project whose investigations were conducted under a transfer of funds from the National Military Establishment to the Bureau of Entomology and Plant Quarantine. The survey activities of the Project were under the direction of Alan Stone and Dale Jenkins in 1947, and under R. I. Sailer in 1948. J. D. Gregson, of the Dominion Entomological Laboratory at Kamloops, British Columbia, also kindly loaned material (noted as "CAN" in the collection records). The 1949 records are on material submitted by W. C. Frohne and R. W. Williams, of the U. S. Public Health Service (noted as "USPHS"), most of which has been deposited in the National Museum. I wish particularly to thank my co-workers Alan Stone and R. I. Sailer for their very helpful taxonomic advice and interpretations of the field records.

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[1]This work was conducted under funds allotted by the National Military Establishment to the Bureau of Entomology and Plant Quarantine.

KEYS TO ALASKAN SPECIES OF CULICOIDES

Females

1. Wings hairy, the macrotrichiae extending from apex of wing into anal cell and base of medial cell; large species (1.5–2.5 mm.) 2
   Wings practically bare, macrotrichiae confined to a few at apex, wings usually with two faint dark transverse bands, the second radial cell usually included in a light spot; small species (1.0–1.5 mm.) ..... **obsoletus**
2. Wing markings extensive, the second radial cell included in a light spot; very large species (2.0–2.5 mm.) 3
   Wing markings confined to costal margin, second radial cell included in a dark spot; medium sized species (1.5–2 mm.) 5
3. Dark spot present in center of pale area in cell Cu_1 ..... **yukonensis**
   Dark spot absent in center of pale area in cell Cu_1 4
4. Eyes usually contiguous above bases of antennae; two oblique brown sublateral bands usually present on mesonotum (inland species) ..... **cockerellii**
   Eyes usually separated by the width of at least one corneal facet; mesonotal markings restricted to three very narrow longitudinal fumose striae (coastal species) ..... **tristriatulus**
5. Wing typically with large round light spots, over crossvein and at tip of radial cells extending into cell M_1, the macrotrichiae very dense and long; mesonotum gray with prominent brown pattern; single large spermatheca present ..... **alaskensis**
   Wing typically unmarked or with faint spots over crossvein and at front margin of cell R_4 just past radial cells; mesonotum unicolorous brown; two spermathecae ..... **unicolor**

Male Genitalia

1. Ninth tergite truncate or notched at tip, the apicolateral processes far surpassing apex and divergent; inner margin of basistyles not spinose; dististyles slender and incurved at tip 2
   Ninth tergite rounded at tip, the apicolateral processes absent or rather small and convergent; inner margin of basistyles spinose or dististyles roundly expanded at tip 3
2. Ventral root of basistyle absent; parameres with foot-shaped base, expanded on proximal third, rather straight with abruptly bent simple tips; membrane posterior to ninth sternite spiculate ..... **alaskensis**
   Ventral root of basistyle well developed; parameres with clubbed base, sinuous slender body and lateral spines fringing the apex; membrane posterior to ninth sternite bare ..... **unicolor**[2]
3. Apicolateral processes absent; inner margin of basistyle without spinules, the ventral root much longer than dorsal root; aedeagus with broad shoulders and short blunt apex ..... **obsoletus**[2]
   Apicolateral processes present; inner margin of basistyle spinose, the ventral and dorsal roots subequal; aedeagus gradually tapered to apex 4
4. Spinose portion of inner margin of basistyle with prominent hump; ninth tergite transverse between apicolateral processes ..... **yukonensis**
   Spinose portion of inner margin of basistyle straight, not humped; distal margin of ninth tergite expanded in a mesal point 5
5. Apicolateral processes greatly reduced; distal portion of aedeagus broad (1.5 times as long as broad) with bluntly rounded tip; parameres long and slender ..... **cockerellii**[2]
   Apicolateral processes well developed; distal portion of aedeagus slender (over twice as long as broad) and gradually tapering to a blunt point; parameres with contiguous portion short and stout ..... **tristriatulus**

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[2]Based on material from outside Alaska.

Culicoides obsoletus (Meigen)

(Figs. 17, 18, 24)

Ceratopogon obsoletus Meigen, 1818, Syst. Beschr., 1: 76.
Culicoides obsoletus, Edwards, 1926, Trans. Ent. Soc. Lond. 74: 405 [syn.: *sanguisugus* (Coq.)]; Root and Hoffman, 1937, Amer. Jour. Hyg. 25: 155; Edwards, 1939, Brit. Bloodsucking Flies, pp. 45, 143; James, 1943, Pan-Pac. Ent. 19:148; Jenkins, 1948, Mosquito News 8: 153.
Ceratopogon sanguisugus, Coquillett, 1901, Proc. U. S. Nat. Mus. 23: 604.
Culicoides sanguisugus, Malloch, 1915, Bull. Ill. St. Lab. Nat. Hist. 10: 301; Hoffman, 1925, Amer. Jour. Hyg. 5: 281.
Ceratopogon hirtulus, Coquillett, 1900, Proc. Wash. Acad. Sci. 2: 396 (new synonymy).
Culicoides hirtulus, Root and Hoffman, 1937, Amer. Jour. Hyg. 25: 173.
Culicoides biguttatus Jenkins [not Coquillett], 1948, Mosquito News 8: 154.

A small, shining, poorly marked, brown species.

Female.—Length 1.0–1.5 mm.; wing 1.2 mm. by 0.6 mm. Eyes contiguous, antennal ratio 1.13, last five segments in proportion of 18:20:20:20:32. Maxillary palpus (fig. 14) slender, third segment slightly swollen with small sensory pit. Mesonotum shining brown, without markings. Legs uniform brownish. Wing (fig. 13) nearly bare, the hairs confined to the tip; second radial cell more or less included in a light spot; one dark spot and two light spots on anterior margin, other wing markings extensive but diffuse. Spermathecae (fig. 20) two, small, subequal, oval; rudimentary third spermatheca and ring present.

Alaska records.—Anchorage-9vii47, (Jenkins), 100 ♀♀, 27vii47, (Jenkins), 50 ♀♀; Anchorage-Palmer MP[3] 20, 29vii47 (Jenkins), 10 ♀♀; Ship Creek, 10 mi. N.E. Anchorage, el. 3000 ft., 31vii48 (Sleeper), 1 ♀; Auke Lake, 25vii49 (Frohne) (USPHS) 6 ♀♀; Connell Lake, 19vii49 (Frohne) (USPHS) 4 ♀♀; Eklutna Flats 12viii48 (Sailer & Dover), 1 ♀; Haines 22viii45 (Chamberlin), 8 ♀♀; Juneau 15vi49, (Frohne) (USPHS) 4 ♀♀; Ketchikan 19vi49 (Frohne) (USPHS) 5 ♀♀; Petersburg 22vii49 (Frohne) (USPHS) 3 ♀♀; Pigot Bay 21vii47 (Jenkins) 25 ♀♀; Richardson Hwy. MP 97.8, 27viii48 (Sailer & Morris) 1 ♀; Seward 20vii49 (Frohne) (USPHS) 3 ♀♀; Spenard 4vii49 (Frohne) (USPHS) 1 ♀; Thane 24vii49 (Frohne) (USPHS) 5 ♀♀; Valdez-30vii49 (Williams) (USPHS) 60 ♀♀, 1viii49 (Williams) (USPHS) 85 ♀♀, 4viii49 (Williams) (USPHS) 3 ♀♀, 18viii49 (Williams) (USPHS) 35 ♀♀; Ward Lake 19vi49 (Frohne) (USPHS) 3 ♀♀; Wrangell 29vii49 (Frohne) (USPHS) 5 ♀♀, 20vi49 (Frohne) (USPHS) 5 ♀♀.

Synonymy.—*C. hirtulus* was described by Coquillett from two females from Virgin Bay, Prince William Sound, Alaska. Both specimens are in the U. S. National Museum; the type in excellent condition, the other consists of a wing and thorax. They appear to be teneral specimens of *obsoletus*, agreeing well with that species in size, palpal structure, wing venation especially in the tuning-fork appearance of vein M and its branches, and in the degree and pattern of restriction of macrotrichiae on the wing surface. The wings are uniformly light colored, without a trace of dark markings, but series of *obsoletus* from

[3]Milepost, abbreviation used in this paper.

many localities have been noted to vary between unmarked to well-marked extremes.

The specimen of *C. biguttatus* (Coq.) from Eklutna Lake recorded by Jenkins (1948) was examined and found to be a poorly marked *obsoletus*. On the basis of known material, *biguttatus* is not known to occur in Alaska.

Culicoides tristriatulus Hoffman

(Figs. 1, 3, 5, 7, 9, 11)

Culicoides cockerelli, var. *tristriatulus* Hoffman, 1925, Amer. Jour. Hyg. 5: 294; Root & Hoffman, 1937, Amer. Jour. Hyg. 25: 157; Vargas, 1945, Rev. Inst. Salub. Enf. Trop. 6: 45.
Culicoides tristriatulus, Jenkins, 1948, Mosquito News 8: 154.
Culicoides sordidellus Jenkins [not Zetterstedt], 1948, Mosquito News 8: 154.

A large, dark brown species with three faint dark striae on mesonotum; wing with second radial cell in light spot, no dark spot in cell Cu_1; eyes narrowly separated.

Female.—Length 2.3 mm.; wing 2.1 mm. by 0.8 mm.

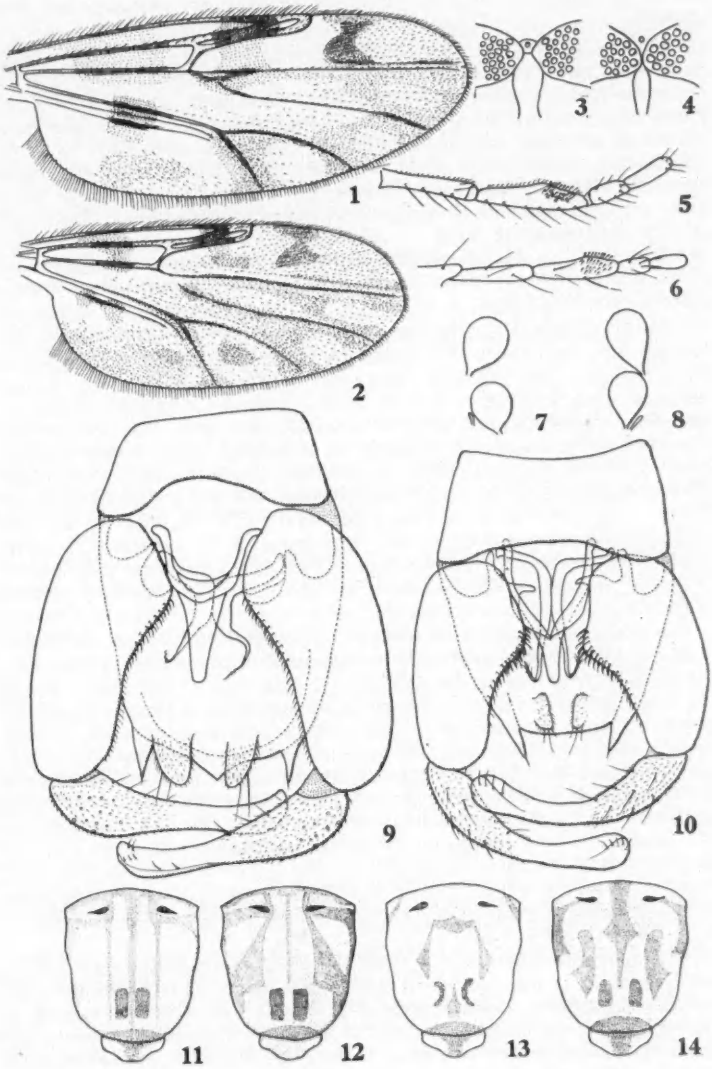
Head dark brown, eyes narrowly separated (fig. 3); antennal ratio 1.3, last five segments in proportion of 20:20:23:26:35. Maxillary palpus (fig. 5) slender, third segment slightly swollen toward distal third, the sensory area beyond with sensillae loosely grouped on the surface of the segment.

Mesonotum (fig. 11) dark grayish pruinose, with three narrow fumose striae running the entire length, bearing long hairs. Scutellum, metanotum, pleura and abdomen pruinose brown. Legs dark brown. Halteres yellowish with dark base.

Wings (fig. 1) grayish hyaline, the anterior veins slightly yellowish; with brownish spots arranged in three transverse bands from the costa: first midway between cross-vein r-m and wing base, narrowly broken between M and Cu, and in anal cell; second band very dark on distal half of first radial cell and base of second, narrowed in cell R_5, broad on base of median fork, narrowly following veins M_1 to third band, usually absent between M_2 and Cu, appearing broadly at base of fork of Cu, following vein Cu_2 broadly to wing margin and vein Cu_1 narrowly to third band; the latter sinuate, with a broad, very dark, hour-glass shaped mark in cell R_5, following costal margin and vein M_1 to wing margin, darkening distal half of cells M_1 and M_2 except for a narrow light spot in each toward apices; cell Cu_1 dark except for a large, rounded, light spot in center. Macrotrichiae long and abundant over distal third and in anal cell, brown on light spots and yellowish on lighter portion of wing.

EXPLANATION OF PLATE I

Culicoides spp. Female wings: 1. *tristriatulus*. 2. *yukonensis;* female eyes: 3. *tristriatulus*. 4. *cockerellii*; female palpi: 5. *tristriatulus*. 6. *yukonensis;* female spermathecae. 7. *tristriatulus*. 8. *yukonensis*; male genitalia: 9. *tristriatulus*. 10. *yukonensis;* female mesonota: 11. *tristriatulus*. 12. *cockerellii*. 13. *yukonensis*. 14. *alaskensis*.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Abdomen long and slender; spermathecae two, subequal, ovoid, the ducts sclerotized at base, rudimentary third spermatheca and ring present.

Male genitalia (fig. 9).—Ninth sternite with only slight mesal excavation, the membrane bare; ninth tergite rounded caudad with moderate median point and apicolateral processes. Basistyle slender, inner side straight with prominent patch of spines from near base becoming slenderer and continuing as setae of same length to apex; dorsal and ventral roots short and subequal; dististyle slender, apex only slightly expanded, with prominent setae. Aedeagus with basal arch not quite half entire length, the anterior arms strong, distal half slender and tapered to a rounded apex. Parameres rather stout, abruptly bent at about proximal third, inner margins approximated about a fifth entire length, the distal third strongly curved and attenuated to fine hairy tips.

Alaska Records.—Anchorage, Fish Creek Flats 26–29vii48 (E. P. Marks) 1♂, 3♀♀, 6 p. 5 l. (reared); Cook Inlet 3ix45 (Chamberlin) 2♀♀; Goose Bay 16vii48 (Gregson) (CAN) 1♀; Kodiak 5viii40 (Pupek) 12♀♀; Pigot Bay 21vii47 (Jenkins) 100♀♀; Valdez—14vi47 (Travis-Wilson) 12♀♀, 18vii47 (Survey) 20♀♀, 18vi48 (Travis) 100♀♀, 18vi48 (Travis & Knipling) 1♀, 5vii48 (Sailer) 18♀♀, 6vii48 (Sailer) 400♀♀, 10vii48 (Marks) 150♀♀, 10vii48 (Gregson) (CAN) 14♀♀, 13vii48 (Marks) 700♀♀, 15vii48 (Marks) 23♀♀, 24viii48 (Sailer) 74♀♀, 25viii48 (Sailer & Morris) 20♀♀, 8–27vii48 (Marks) many larvae, 2 pupae, 2♀♀, 14vi49 (Williams) (USPHS) 8 larvae, 16vii49 (Frohne) (USPHS) 2♀♀, 1viii49 (Williams) (USPHS) 1♀, 14viii49 (Williams) (USPHS) 5♂♂, 30♀♀, 5 larvae, 12 pupae.

Culicoides tristriatulus is almost indistinguishable from *cockerellii* except by the male genitalia, which show several marked differences. In males of *tristriatulus* the apicolateral processes of the ninth tergite are much better developed, the tip of the aedeagus is much longer and slenderer, and the parameres have the straight contiguous portion shorter and stouter than in *cockerellii*. The typical mesonotal pattern of *tristriatulus* is shown to a greater or less degree by several varieties of *cockerellii* in a large series of specimens from western United States examined by the writer, and is therefore of little use in separating the two species. With caution, however, *tristriatulus* females can be separated from those of *cockerellii* by the distance between the eyes, which is usually greater than the width of one corneal facet in *tristriatulus*, but less in *cockerellii*, whose eyes usually are contiguous for a short distance (figs. 3, 4).

The specimen recorded by Jenkins (1948) as *C. sordidellus* (Zett.) from Pigot Bay was examined and found to be a *tristriatulus* with particularly poorly defined wing markings. The series of about a hundred females collected by Jenkins at the same time and place are definitely referable to *tristriatulus*. The similarity of these two species resembles that noted by Edwards (1939, p. 147) between *sordidellus* from Greenland and his *grisescens* from Britain. Edwards' figures of the wing and male genitalia and his description of *grisescens* bear so

many points of resemblance to *cockerellii* that the synonymy of *grisescens* with the earlier American species may be seriously suggested.

The male described and figured by Vargas (1945) as *tristriatulus* from Oaxaca, Mexico, was kindly lent to the writer by Dr. Vargas. Vargas evidently drew the parameres from an aspect which produced foreshortening, as his specimen actually shows them somewhat more slender and with finely, but very definitely hairy tips, as in the *pulicaris* group. Other details checked closely with Vargas' figures. It is the writer's opinion that Vargas' material is not *tristriatulus*, but more likely represents the male of *elutus* Macfie (1948), described from females from the neighboring Mexican state of Chiapas.

Culicoides cockerellii (Coquillett)

(Figs. 4, 12)

Ceratopogon cockerellii Coquillett, 1901, Proc. U. S. Nat. Mus. 23: 603.
Culicoides cockerelli, Kieffer, 1906, Gen. Insectorum, fasc. 42: 54; Hoffman, 1925, Amer. Jour. Hyg. 5: 293; Root and Hoffman, 1937, Amer. Jour. Hyg. 25: 157; James, 1943, Pan-Pac. Ent. 19: 149.

Female.—Length 2.5 mm.; wing 2.25 mm. by 0.9 mm. Almost indistinguishable from *tristriatulus* Hoffman, but differing in several small points. Eyes contiguous mesad (fig. 4); antennal ratio 1.18; last five segments in proportion of 16:18:20:22:30. Mesonotum usually with a basic pattern consisting of a pair of oblique brown bands from humeral pits toward wing bases (fig. 12).

Male genitalia.—(Wyoming material). Spines on inner margin of basistyle better developed than in *tristriatulus;* apicolateral processes smaller; dististyle with apex slightly more roundly expanded; aedeagus shorter with distal portion broader; parameres with the straight contiguous portion longer and not so stout as in *tristriatulus*.

Alaska records.—Glenn Hwy. MP 137.5, 8ix48, 18 ♀ ♀; Richardson Hwy.—MP 162.7, 7ix48, 10 ♀ ♀, MP 188.7, 7ix48 1 ♀; Slana Road MP 70, 29viii48 2 ♀ ♀ (all coll. Sailer and Morris).

This is an exceedingly variable and poorly known species, which is common and widespread in western North America. A large amount of material has been examined and an analysis of the variation will be presented in another paper dealing with California *Culicoides*.

Culicoides yukonensis Hoffman

(Figs. 2, 6, 8, 10, 13)

Culicoides yukonensis Hoffman, 1925, Amer. Jour. Hyg. 5: 291; Root and Hoffman, 1937, Amer. Jour. Hyg. 25: 157; Jenkins, 1948, Mosquito News 8: 153.

A large species resembling *tristriatulus* and *cockerellii*, but a dark spot in center of cell Cu_1.

Female.—Length 2.6 mm.; wing 2.1 mm. by 0.75 mm. Eyes contiguous; antennal ratio 1.26, last five segments in proportion of 20:20:20:20:32. Maxillary palpus as in fig. 6, proportion of segments 6:22:24:9:11. Mesonotum pruinose gray, almost silvery, with variable brown markings usually consisting of a pair of long triangular sublateral bands, with the anterior ends connected by a transverse band (fig. 13).

In some individuals the lateral markings may extend much further toward the sides and in others the median transverse band or even all markings may disappear. Wings (fig. 2) with markings of the ***pulicaris*** group of species, a dark spot in center of cell Cu_1; macrotrichiae abundant. Spermathecae two, subequal, ovoid, with marked taper to the ducts, rudimentary third spermatheca and ring present.

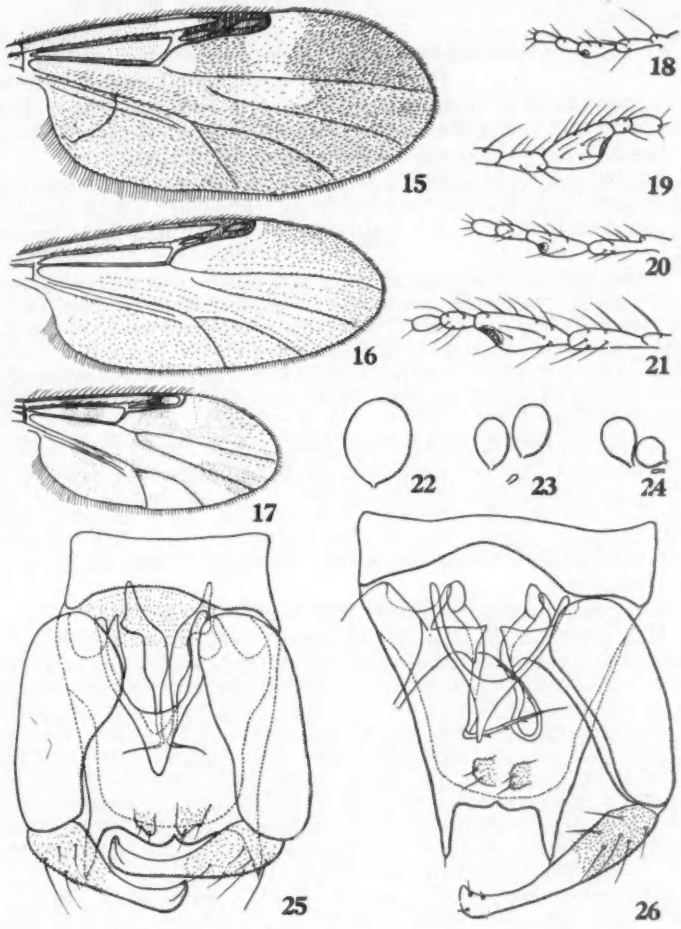
Male genitalia (fig. 10).—Ninth sternite about twice as broad as long, not excavated on posterior margin, the membrane bare; ninth tergite rounded caudad with well developed convergent apicolateral processes. Basistyle with pronounced hump on inner margin, bearing many spinose setae; dorsal and ventral roots short and subequal; dististyle curved with apex roundly expanded. Aedeagus with rather long, narrow arch extending about two-thirds the entire length, the anterior margin in a Morrish-arch shape, posterior third very slender, ending in a bluntly rounded median point. Parameres very long and slender, abruptly bent at proximal third, middle portion almost straight and contiguous, very gradually tapering to very slender, ventrally curved, sharp, hairy tips.

Alaska records.—Alcan Hwy.—MP 1376.9, 31viii48 (Sailer & Morris) 6♀♀, MP 1247.6, 14vii48 (Sailer & Morris) 35♀♀; Anchorage 9vii47 (Jenkins) 13♀♀; Ship Creek 10 mi. N.E. Anchorage, el. 3000 ft. 31vii48 (Sleeper) 1♀; Cook Inlet 3ix45 (Chamberlin) 50♀♀; Eklutna Flats—12viii48 (Sailer & Dover) 22♀♀, 17viii48 (Sailer & Morris) 12♀♀, same, 13ix48, 2♀♀; Fairbanks—5 mi. N. (AIS Sta. No. 102) 19vi-2vii49 (Lienk & Esselbaugh, emergence trap) 61♂♂, 29♀♀, 25vi44 (Stage) 32♀♀; Glenn Hwy. MP 169, 7vii47 (Jenkins) 30♀♀; Haines 22viii45 (Chamberlin, on man) 14♀♀; Matanuska 7viii44 (Chamberlin, trap) 20♀♀; Nabesna Road—9vii47 (Storm) 40♀♀, MP 91, 28viii48 (Sailer & Morris) 1♀; Otter Creek, Fort Richardson 21viii48 (Hackney) 3♀♀; Richardson Hwy.—MP 97.8, 27viii48 (Sailer & Morris) 25♀♀, MP 204.2 7ix48 (Sailer & Morris) 1♀, MP 286, 1ix48 (Sailer & Morris) 1♀; Slana Road—MP 3.5, 29viii48 (Sailer & Morris) 25♀♀, MP 25.7 11vii48 (Sailer & Daley) 1♀; Steese Hwy.—MP 61 3ix48 (Sailer & Morris) 4♀♀, MP 139.1, 4ix48 (Sailer & Morris) 4♀♀, MP 145.2, 4ix48 (Sailer & Morris) 20♀♀; Valdez 18viii49 (Williams) (USPHS) 2♀♀.

The male genitalia of ***yukonensis***, which are here described for the first time, show the close relationship of this species to the European ***pulicaris*** (L.) and ***halophilus*** Kieffer, suggested by the similarity in wing markings (*cf.*, Edwards, 1939, pp. 46–48, 144). The chief differences between ***yukonensis*** and the European species consist in the mesonotal markings, which in the latter are more of the type found in ***luteovenus***

EXPLANATION OF PLATE II

Culicoides spp. Female wings: 15. *alaskensis*. 16. *unicolor*. 17. *obsoletus;* female palpi: 18. *obsoletus*. 19. *unicolor*, Fairbanks. 20. *unicolor*, Valdez. 21. *alaskensis;* female spermathecae: 22. *akaslensis*. 23. *unicolor*. 24. *obsoletus;* male genitalia: 25. *alaskensis*. 26. *unicolor*, cotype from Eureka, Calid.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Root and Hoffman in America. The differences in male genitalia are very slight, according to Edwards' figures, but in ***yukonensis*** the aedeagus has the posterior point of ***halophilus*** and the cleft anterior margin as in ***pulicaris***, and the ninth sternite is less emarginate than in either species; the parameres are more of the type shown for ***halophilus***.

Culicoides alaskensis Wirth, new species
(Figs. 14, 15, 21, 22, 25)

A moderate-sized hairy species; wing with radial cells in a dark spot, prominent light spots only over cross vein and at tip of radial cells.

Female.—Length 2.0 mm.; wing 1.7 mm. by 0.7 mm.

Head brown; eyes widely separated; antennal ratio 1.48, last five segments in proportion of 16:16:18:21:30. Maxillary palpus (fig. 21) in proportion of 6:20:22:10:8, third segment swollen with large sensory pit.

Mesonotum (fig. 14) pruinose gray, with brown markings as figured, these variable, the median marking most often reduced or absent; with long yellowish and dark hairs, these often appear to arise from minute black punctures. Scutellum pruinose gray, darker in middle; metanotum, pleura and abdomen pruinose brown. Halteres yellowish with stems darker. Legs brown, fore femora with apical and all tibiae with basal light rings.

Wings (fig. 15) with dark spot over radial cells; usually three definite light spots, the first over cross-vein, the second across cell R_5 at tip of second radial cell, and the third more or less contiguous below the second in cell M_1. In addition a few specimens show traces of light spots in tips of cells R_5, M_1, M_2, Cu_1, and in anal cell. Macrotrichiae abundant and quite strong over entire wing except in front of M before the cross vein.

Abdomen. Spermathecae one, very large, oval (fig. 22).

Male genitalia (fig. 25).—Ninth sternite very short, broadly excavated, the membrane spiculate about halfway to arch of aedeagus; ninth tergite with sides parallel, apicolateral processes long and slightly divergent, posterior margin rounded with slight mesal cleft. Basistyle slender, ventral root greatly reduced, dorsal root short; dististyle slender, with incurved tips. Aedeagus with rounded basal arch two thirds of entire length, the apex conical with bluntly pointed tip. Parameres with marked basal foot-shaped expansion; straight about two-thirds their entire length, proximal third of straight portion stout, rapidly narrowed, the distal half very slender; extreme apex abruptly bent ventro-laterad, with slender simple tip.

HOLOTYPE male, Valdez, Alaska, July 12, 1949, R. W. Williams (USPHS) (Type No. 59394, U.S.N.M.), ALLOTYPE, same as type, Aug. 1, 1949. Paratypes: 6♂♂, 7♀♀, July 12, Aug. 1, 1949; 1♀, Spenard, Alaska, July 4, 1949, W. C. Frohne (USPHS); 7♀♀, Anchorage, Alaska, July 4, 1947, D. W. Jenkins.

The single spermatheca, the palpal structure, type of mesonotal pattern and hairy wings of the female, as well as the genitalia of the male, place ***alaskensis*** in the ***crepuscularis*** group of species. The wing pattern,

however is distinct, *crepuscularis* Malloch and *canithorax* Hoffman both having wings with many well-developed light spots. Two European salt marsh species, *salinarius* Kieffer, and *circumscriptus* Kieffer, belong to this group, having wing patterns, spermathecae, and male genitalia of a very similar type, but differ markedly in a prominent stippling of tiny brown dots on the mesonotum, which are only suggested in *alaskensis*. *C. canithorax* is a troublesome salt marsh species in the southeastern United States.

Culicoides unicolor (Coquillett)

(Figs. 16, 20, 23, 26)

Ceratopogon unicolor Coquillett, 1905, Jour. N. Y. Ent. Soc. 13: 65.
Culicoides unicolor, Hoffman, 1925, Amer. Jour. Hyg. 5: 279; Root and Hoffman, 1937, Amer. Jour. Hyg. 25: 173.

A medium-sized unmarked species with hairy wings.

Female.—Length 1.5 mm.; wing 1.5 mm. by 0.5 mm. Eyes well separated; antennal ratio 1.04; last five segments in proportion of 14:14:16:16:18. Maxillary palpus in proportion of 6:18:22:8:10, third segment swollen with a large shallow sensory pit (fig. 19) in the Fairbanks specimens, slender with a small deep pit (fig. 20) in the Valdez material. Mesonotum grayish brown pruinose, without definite pattern. Wings (fig. 16) unmarked, the radial cells somewhat darker; macrotrichiae short and stout, covering nearly all the wing except radial and basal cells, a small light spot just beyond radial cells due to absence of macrotrochiae. Legs uniform light brown. Spermathecae (fig. 23) two, oval, the base of ducts sclerotized; rudimentary spermathecae and ring present.

Male genitalia.—Those of a cotype from Eureka, California, as in fig. 26.

Alaska records.—Connell Lake 19vi49 (Frohne) (USPHS) 1 ♀; Fairbanks (AIP Sta. No. 102) 19vi48 (Lienk & Esselbaugh, emergence trap) 2 ♀ ♀; Haines 14vi49 (Frohne) (USPHS) 5 ♀ ♀; Petersburg 22vii49 (Frohne) (USPHS) 2 ♀ ♀; Valdez 30vii49 (Williams) (USPHS) 8 ♀ ♀.

The Valdex specimens agree closely with the type series from Eureka, California, even in the slender third palpal segment with small deep sensory pit in the female. The Fairbanks specimens have a larger third palpal segment with large shallow sensory pit resembling that possessed by California *unicolor* reared from tree holes which in addition have a more or less pronounced wing pattern and mesonotal pattern. In all probability the Fairbanks specimens were breeding in the stream over which the emergence trap (for blackfly captures) was placed. Thus it seems that we have a quite variable species whose breeding habits also vary from tree holes to salt marshes to slow streams. Only by an analysis of much more material including males and immature stages will it be possible to determine whether, as suggested by the variation in appearance and habits, more than one species is involved. The eastern species, *piliferus* Root and Hoffman, has male genitalia very similar to that of males from the type series and the tree hole material from California.

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THE ECOLOGY OF ANIMALS, by CHARLES ELTON. New York, Wiley and Sons, Inc. 97 pp. 3rd edition, 1950. Price $1.25.

There are few aspects of biology so difficult to summarize as animal ecology. Perhaps there is no special difficulty inherent in the field; but ecology is diverse in subject matter and difficult to organize around central ideas. Animal ecology seems more to be regarded as an area of study than as a scientific discipline. In *The Ecology of Animals*, however, Charles Elton has written a brief account of one aspect of the field which may be regarded as a definite approach or discipline, the study of animals in natural communities.

Elton begins his introduction to the field by discussing the scope of animal ecology and its dependence on other fields. The description of how animal communities are studied begins with ecological surveys, the collection and listing of animals in their communities and what information may be obtained from such lists. More clearly ecological aspects of the study are considered in the relations among animals and between animals and environment. The more difficult quantitative treatment of communities is discussed—first the statistics of animal communities, the measurement of average populations in them, and then their dynamics, the interactions and the fluctuations of populations. There is, finally, a brief account of how problems in economic ecology rely on these various techniques, particularly those of population measurement.

The approach is thus centered around problems in ecology, the description of how an ecologist goes about his business and what results he is likely to get. It is not primarily a book about ecological ideas, as is the other such short introduction, W. C. Allee's *Animal Life and Social Growth*. As a discussion of ecological problems it is necessarily introductory, not having details of the methods used and accounts of advances in sampling, especially of vertebrates, since it was first published (1933). For the introduction which it is, Elton, who is perhaps the ablest writer in the field, has written a book that is informative to the outsider and good reading for the biologist acquainted with ecology.

A companion *Plant Ecology* by Leach is available in the same series of Methuen's Monographs on Biological Subjects. This British series is now being published in this country by Wiley and Sons, and volumes now available here or soon to be published include: *The Classification of Animals*, by W. T. Calman; *Mendelism and Evolution*, by E. B. Ford; *Plant Viruses*, by K. M. Smith; *The Chromosomes*, by M. J. D. White; *Insect Physiology*, by V. B. Wigglesworth; *Cytological Technique*, by J. R. Baker; *The Measurement of Linkage in Heredity*, by K. Mather.—ROBERT WHITTAKER.

THE AEDES (OCHLEROTATUS) PUNCTOR SUBGROUP IN NORTH AMERICA

(Diptera, Culicidae)

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During the last three years the author has had the opportunity of making three collections of larval-adult associated specimens at two different points in the North American Arctic. This material, along with the larval-adult associated specimens of northern *Ochlerotatus* in the collections of the United States National Museum and the Canadian Division of Entomology which were also studied, disclosed considerable new information for *punctor* (Kirby) and its related species. The results of this study are reported here.

The *punctor* subgroup is a division of Edwards' (1932) Group G (*communis*-group) of the subgenus *Ochlerotatus*. This group, along with Groups F and H, is characterized by the absence of tarsal bands. Group F is distinct from Group G in possessing median or submedian longitudinal pale-scaled areas on the scutum (however, *thelcter* Dyar of Group F has the scutum rather uniformly golden-brown) and in lacking scales on the paratergite and meteusternum of the female. The only northern Nearctic species occurring in this group is *trivittatus* (Coquillett). Group H is distinct from Group G with certainity only in the larva, that stage having the siphon with numerous pairs of hair tufts. Group H is represented in North America by only one species, *trichurus* (Dyar).

The *punctor* subgroup is distinct from the other subgroups of Group G by a combination of the following: basal lobe of basistyle of male genitalia expanded, setose, and tubercular in appearance, with a stout elongate seta or spine at the tergal margin; apical lobe with short clinging setae, some or many of the most sternal-lying of these being flattened and striated (scale-like); and claspette appendage curved bladelike in lateral view, broadest at the curved portion, apically elongate-tapered.

The *punctor* subgroup includes the following species: *punctor* (Kirby), *aboriginis* Dyar, *hexodontus* Dyar, *implacabilis* (Walker), and *punctodes* Dyar. The first three names represent a superspecies and the last two another. The members within each of these two superspecies are indistinguishable from each other on the basis of male genitalia, but the two superspecies themselves are readily separated on that basis. The subgroup is confined to the northern half of the Nearctic and Palaearctic Regions, with extensions south of this area occurring only at high elevations.

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Considering the total North American distribution of the five species included here, sufficient overlap occurs in the known recognition characters (all color) of the females so as to make the writing of a single key to this stage impossible. However, present evidence indicates that it will be possible in at least some cases to identify the species of the subgroup occurring in any specific locality, provided that sufficient larval-associated specimens have been studied first from that region to indicate the exact range of variation in characters occurring there. For example, at Great Whale River, Quebec where only ***hexodontus*** and ***punctor*** were found, it was possible to identify all the wild-captured females of these two species on the basis of a study of the larval-associated collections made there.

Since the larvae of the five species of the ***punctor*** subgroup are completely distinct in almost all cases (a slight overlap occurring in certain areas between ***punctor-hexodontus*** and ***punctor-punctodes***), it has been possible to prepare and include a key to this stage. It is believed that the generalized description of the larvae of the species of the ***punctor*** subgroup given below will eliminate most, if not all, of the other *Aedes* larvae of the northern Nearctic region; thus making it possible to utilize the key. The bionomics of the members of this subgroup are being published in detail at a later date by Dr. D. W. Jenkins.

It is desired to gratefully acknowledge the help of the following in making it possible to see material: Alan Stone, United States National Museum, Washington; Guy Shewell and Thomas N. Freeman, Division of Entomology, Science Service, Ottawa, Canada; and H. H. Ross, Illinois Natural History Survey. Type material was examined for me through the kindness of Peter F. Mattingly, British Museum (Natural History), London.

In the distribution section of each species, the abbreviations "U.S.N.M." and "C.N.C." are used to denote, respectively, the United States National Museum, Washington, D. C., and the Canadian National Collection, Entomology Division, Science Service, Ottawa, Canada.

Literature distribution records are not utilized because of the uncertainty of so many identifications.

The extensive collection of larval-associated adults made by the 1947 Alaskan Mosquito Project, Bureau of Entomology and Plant Quarantine and so heavily drawn upon for this study was largely gathered by Alan Stone, B. V. Travis, and D. W. Jenkins.

GENERALIZED DESCRIPTION FOR PUNCTOR SUBGROUP

ADULT. *Male.*—Scutum normally scaled. Similar to the female in coloration characters. However, the pleural scale patches have a tendency to become reduced or obsolescent in the male. Lateral abdominal hairs with a yellowish tinge, or all yellow.

Female.—Torus with scales medially, and frequently dorsally; usually some dusky hairs also present medially. Proboscis all dark. Vertex without prominent dark patches in the lateral pale broad-scaled area. Scutal scale color-pattern extremely variable, even within a single species. The area over the wings and across the prescutellar area always

paler than the rest, the scutellar scales of the same shade of color as the prescutellar space. The scutum may be without markings and range from yellow to dark brown, or there may be a broad longitudinal single or divided dark band medially, or a posterior pair of submedian half stripes, or any combination of these three conditions. Bristles over wing base and on scutellum usually yellow, frequently however, those over the wing base and even some of those on the scutellum may be brown (brownish to black in Quebec and Baffin Island specimens of ***hexodontus***). Wing dark-scaled, pale scales present or absent basally on costa and vein 1. ***Ppn*** (posterior pronotum) with yellowish or brownish narrow-curved and narrow (may be some intermixed broadened scales present) scales dorsally, broadened paler scales below; with 7–16 (usually 8–13) bristles present posteriorly, occasionally 1–2 bristles present dorsally in a more or less detached condition. No hypostigial scale patch (the area just ventrad of the mesothoracic spiracle). The space between the anterior coxa and the sternopleuron bearing a scale patch, usually continuous dorsally with the propleural (proepisternum) patch. Subspiracular scale patch separate from ***ppn*** scaling. Dorsal sternopleural scale patch reaching the antero-medial angle of the sternopleuron. Mesepimeral scale patch extending to or very near the ventral margin of the sclerite anteriorly; 1–6 lower mesepimeral bristles present. Meteusternum (sclerite above hind coxa) with a scale patch. Mid femora and tibiae with or without scattered pale scaling anteriorly. Abdominal tergites basally banded, no scattered pale scales on II–VI (the Umiat series of ***punctor*** have the dark portion of these segments poorly differentiated from the basal bands, and some scattered pale scales may even be present). Abdominal sternites all white scaled, or with either longitudinal median or transverse apical dark-scaled bands, or with both; VIII with considerable scaling present.

LARVA. *Head:* Antenna spiculate; antennal hair tuft inserted before the middle, with 2–7 branches (6–9 in ***aboriginis***, however); the longest terminal appendage with a subapical constriction, the two subapical appendages distinctly unequal. Head hair 6 anterior to, and on or near to a longitudinal line with 5, 4 mesad to the base of 6, 7 on a level between that of 5 and 6 (on skins 7 appears on a level with, or slightly anterior to a level with 6); hairs 5, 6, and 7 prominently developed. Arrangement of the remaining head hairs as in figure 7. Inner mouth brush hairs with comb-like tips. *Thorax:* Prothoracic hairs 1, 2, and 3 approximately equal in development. No prominent spine associated with the meso- and metathoracic pleural hair tufts. *Abdomen:* Lateral hair of abdominal segment II at least half as long as the dorsal-lateral hair of that segment. Comb composed of an even or irregular row of teeth (5–20), or a small patch of prominent scales (23–40); the outstanding portion of each tooth (except in ***aboriginis*** where the comb elements are more scalelike) elongate, acutely pointed and as long or longer than the base; the basal portion of each tooth with a lateral fringe. Siphon index approximately 3.0; siphon hair tuft inserted before the middle but beyond the base of the last pecten tooth, with 3–8 branches. Pecten composed of an evenly arranged line of 9–24 dark acutely-tapered teeth, each tooth with a ventral denticle before the middle and with 1–4 smaller denticles associated with it. Anal segment

with the plate complete or narrowly incomplete; *lh* single, about equal to the anal plate in length; *isc* with 3–9 (single in *implacabilis*) branches; *osc* single. Ventral brush with 16–24 tufts, the basal 0–4 tufts not attached to the lateral bar of the grid.

KEY TO FOURTH STAGE LARVAE

1. *Isc* single; (comb consisting of a row of 5–7 very prominent teeth)..**implacabilis**
   Isc with 3 or more branches..... 2
2. Comb consisting of a patch of 23–39 scales; head hair 5 with 4–7 branches; anal plate incomplete; antennal hair with 6–9 branches).....**aboriginis**
   Comb consisting of an even or irregular row of 5–19 teeth; head hair 5 single to triple..... 3
3. Comb consisting of a row of 5–9 (rarely 10 on one side) large teeth; (anal plate complete).....**hexodontus**
   Comb consisting of an even or irregular row of 10–19 teeth..... 4
4. Anal plate incomplete ventrally; the lateral hair of abdominal segments III–VI single or double but 2-branched at least once on each specimen; dorsal pair of anal gills usually equal to or shorter than the anal plate (may be up to 1.4 times longer).....**punctodes**[2]
   Anal plate complete (occasionally partially or entirely broken in specimens from the coastal belt of Alaska where *punctodes* is endemic); the lateral hair of abdominal segments III–VI single or double (however, never observed other than single in the range of *punctodes*); dorsal pair of anal gills 1.5–3.0 times longer than the anal plate (down to 1.1 times longer in some of the specimens with incomplete anal plates).....**punctor**[2]

Aedes (Ochlerotatus) punctor (Kirby)

1837. *Culex Punctor* Kirby, *in* Richardson's Fauna Bor.-Amer. 4: 309 (2 males). TYPE LOCALITY: Canada. Taken in 65° N. Lat. (Richardson, on 2nd Sir John Franklin expedition).[3] TYPE: Howard, Dyar, and Knab (1917) state the type series consists of 2 males in the British Museum, whereas Theobald (1901) reported that it consisted of 2 males and 1 female. However, P. F. Mattingly has informed me that he could find no trace of the *punctor* types in the British Museum.

1848. *Culex provocans* Walker, List Dipt. Brit. Mus. 1: 7 (male). TYPE-LOCALITY: Canada. Nova Scotia (from Lt. Redman's collection). TYPE: 1 male, 1 female (cotypes) in British Museum. Male genitalia lost. Identified as types by Waterhouse. Both specimens in rather poor condition.

1905. *Culicelsa auroides* Felt, N. Y. State Mus. Bull. 97: 449 (1 female with associated larva). TYPE-LOCALITY: United States. Elizabethtown, New York (Felt). TYPE: Probably in the New York State Museum, Albany.

1905. *Grabhamia punctor* Kirby. Dyar, Jour. N. Y. Ent. Soc. 13: 186. Different combination.

1919. *Aëdes punctor* Kirby. Dyar, Ins. Insc. Mens. 7: 14. Synonomized *auroides*.

1920. *Aëdes punctor* Kirby. Dyar, Ins. Insc. Mens. 8: 3. Synonomized *provocans*.

1921. *Aëdes* (*Heteronycha*) *punctor* Kirby. Dyar, Trans. Royal Canad. Instit. Toronto 13: 95. Different combination.

ADULT. *Female.*—On the basis of markings, particularly those of the scutum, this species appears to be extremely variable; but from a study of the available larval-associated female specimens, it appears that at least two general varieties or populations occur within North American *punctor*. Both adult (female) and larval characters have

[2]It will be seen that no single character nor combination of characters will separate all specimens of these two species for localities where their ranges overlap.

[3]Dr. T. N. Freeman, Division of Entomology, Dept. of Agr., Ottawa, Canada, has informed me that by a perusal of the diaries of the 2nd Sir John Franklin expedition he has determined the location of the expedition at 65° N. Lat. to have been between Fort Norman and Norman Wells, N. W. T.

been found to support the presence of these two forms. However, until larval-associated females are available from many other portions of the total *punctor* range, it will not be possible to definitely define the limits of these two populations; but from the data at hand a preliminary attempt may be made.

(a) *"Type punctor" variety.* Torus usually paler laterally. Scutum yellow (occasionally yellowish-white or at the other extreme yellowish-brown), marked with a black or dark brown broad median longitudinal band (frequently longitudinally divided medially by a thin line or stripe of pale scaling), with a paired submedian longitudinal dark area on posterior half of scutum (often obscured or missing altogether), prescutellar area and scutellum with scales of a paler shade than those of scutal background pattern, rarely no dark scutal markings present at all. The scutal background color is consistently darker in the specimens from Northwest Territories, British Columbia, and Alaska. Wing dorsally all dark, rarely 1–4 pale scales basally on costa. Mid femur with few or no scattered pale scales anteriorly. Larval-associated specimens seen from: Dublin, New Hampshire; White River, Ontario; Moose Factory, Ontario; Mile 126 (railway), Cochrane to Moosonie, Ontario; Great Whale River, Quebec; Saw Mill Bay, Northwest Territories; Ft. Nelson, British Columbia; and Anchorage area, Alaska. All of these localities are within the tree line.

(b) *"Tundra" variety.* Torus all dark. Scutum brown, darker markings absent or occasionally only very faintly demarked. Wing with a small to large patch of pale scales basally on the costa. Mid femur with few or no scattered pale scales anteriorly. The Umiat series differs from all the others seen in having the pale scaling of the abdominal tergites very extensive laterally and the apical portions of each segment (the normally dark-scaled portion) with the scaling brownish and poorly differentiated from the basal and lateral pale bands. Some scattered pale scales may even be present in the normally dark-scaled portions. Larval-associated specimens seen from: Raindeer Depot, Mackenzie Delta, Northwest Territories and from Umiat, Alaska (69° 24′ North latitude).

Male.—Genitalia as in figures 1, 3, and 5.

LARVA. *Head:* Head hairs 5 and 6 single or double (5 twice triple in Moose Factory specimens), 7 with 3–6 branches. *Abdomen:* Dorso-lateral hair of segments I and II with 1–2 branches (rarely 3–4 on I and 3 on II in Umiat material); lateral hair of segment I–VI single or double (of segment II occasionally with 3 or even more). Comb consisting of an irregular row or patch of 10–19 prominent teeth. Anal plate ventrally complete from immediately basad of the ventral brush (incomplete or more nearly so than usual in a number of specimens from Anchorage, the Valdez-Fairbanks highway, and the Livengood road, Alaska). Dorsal pair of anal gills 1.5–3.0 times as long as the anal plate (down to 1.1 times as long in some of the specimens mentioned above in connection with the completeness of the anal plate).

It is believed that a significant larval correlation exists with the two varieties described above from the females. In "type *punctor*" variety, the lateral hair of abdominal segments IV–VI is 100% single; whereas, the "tundra" variety (Umiat series) has this hair only 48–70%

single. Also, in the first variety the lateral hair of abdominal segment II is 97–100% single and in the latter entirely double or triple. It is entirely probable, of course, that these distinctions will break down when more material is at hand.

DISTRIBUTION. Only records based on larvae and larval-associated adults are given here.

ALASKA: Knight collection. 8 males, 6 females, 16 larval skins, Umiat (69° 24′ N. lat. and 152° 8′ W. long.), elev. approximately 600 ft. (Knight, Schultz). U.S.N.M. (all collected by members of the 1947 Alaska Mosquito Project). 25 males (all with genitalia separated) and 16 females, all with associated larval and pupal skins, from the following localities: Anchorage, Anchorage-Palmer (MP–16 and MP–31), Glenn Highway (MP–63 and MP–174), Livengood Road, Fairbanks-Circle (MP–32), Valdez-Fairbanks (MP–131 and MP–148), Long L. on Richardson Hwy, and Eklutna.

CANADA: U.S.N.M. 5 males and 1 female, all with associated larval skins, White River, Ontario (Dyar). C.N.C. 7 males and 4 females, 11 associated larval skins, Ft. Nelson, British Columbia (Mason). 4 females all with larval skins, Saw Mill Bay, Northwest Territories (Hardwick). 1 female, with larval skin, Raindeer Depot, Mackenzie Delta, Northwest Territories (Vockeroth). 2 females, with larval skins, Mile 126, Cochrane to Moosonie railroad, Ontario (Jenkins, Knight). 8 males, 14 females, with associated larval skins, Moose Factory, Ontario (Jenkins, Knight). 13 males, 26 females, with associated larval skins, Great Whale River, Quebec (Jenkins, Knight).

UNITED STATES: U.S.N.M. 4 females, with larval skins, Dublin, New Hampshire (Busck).

DISCUSSION. Unfortunately, the literature dealing with *punctor* throws little or no additional light on the subject of varieties within the species, mainly due to the absence of adequate descriptions of larval-associated female specimens.

Old World *punctor* has not been included in this study because of the complete lack of larval-adult associated material. However, once the North American picture is fully clear it will be of the greatest interest to compare the results with European studies. Marshall's (1938) description of English material of *punctor* indicates that the female is similar to our "type *punctor*" variety. However, the larval comb according to him contains 11–24 teeth, which is a distinctly higher range than yet seen by me in N. A. specimens.

Natvig's (1948) description of northern European *punctor* females would indicate that "type *punctor*" variety is the common form there also.

None of the North American types have been seen by me. The European synonyms have not been included in the table but according to Edwards (1932) include *nemorosa* f. *haplolineata* Schneider, *n.* f. *alineata* Schneider, *sylvae* Martini, and *meigenanus* Dyar. Natvig (1948), from examination of male types, has added *fusculus* Zetterstedt to this list.

An examination of the cotype series of *punctodes* disclosed that specimen 1583 (male) from Unalakleet (Hadwen), Alaska is actually this species.

Aedes (Ochlerotatus) hexodontus Dyar

Figs. 5, 7, and 8

1916. *Aedes hexodontus* Dyar, Ins. Insc. Mens. 4: 83 (males, females, larvae, eggs). TYPE-LOCALITY: United States. Fallen Leaf, Lake Tahoe, California (Dyar). TYPE: 1 male (FE-24), 1 female (FJ-13) (cotypes) in the U.S.N.M. The female with its associated larval skin is here designated as lectotype (specimen FJ-13, collected 7 June, 1916). Male larval skin not located.

1920. *Aëdes cyclocerculus* Dyar, Ins. Insc. Mens. 8: 23 (males, females, larvae). TYPE-LOCALITY: Canada. Prince Rupert, British Columbia (Dyar). TYPE: 1 male (G-22), 1 female (G-24) (cotypes) in the U.S.N.M. The male with associated larval and pupal skins (specimen G-22, collected 11 May, 1919) is here designated as lectotype. Male genitalia not separated.

1920. *Aëdes leuconotips* Dyar, Ins. Insc. Mens. 8: 24 (males, females, larvae). TYPE-LOCALITY: Canada. Prince Rupert, British Columbia (Dyar). TYPE: 1 male (N), 1 female (V-3) (cotypes) in the U.S.N.M. The male with associated larval skin (specimen N, collected 26 May, 1919) is here designated as lectotype. Male genitalia not dissected.

1920. *Aëdes* (*Heteronycha*) *hexodontus* Dyar. Dyar, Ins. Insc. Mens. 8: 168. Different combination.

1921. *Aëdes* (*Ochlerotatus*) *hexodontus* Dyar. Dyar, Ins. Insc. Mens. 9: 73. Different combination.

1946. *Aëdes* (*O.*) *hexodontus* Dyar. Gjullin, Proc. Ent. Soc. Wash. 48: 232. Synonomized *cyclocerculus* and *leuconotips*.

ADULT. *Female.*—As with *punctor*, this species appears to show at least two general varieties or populations that are based upon both adult (female) and larval characters. Also, as with *punctor* the concept of these two varieties are based upon relatively scanty material and many more larval-associated females will be needed from many portions of the total range of *hexodontus* before it will be possible to definitely establish the validity of the two forms.

(a) "*Type hexodontus*" *variety*. Scutum marked exactly as defined for "type *punctor*" variety. Wing with a patch of pale scales basally on the costa. Larval-associated specimens seen from: Lake Tahoe and Truckee, California; Grand Lake, Colorado; and Prince Rupert and Kwinitsa, British Columbia.

(b) "*Tundra*" *variety*. Scutum brown, darker markings absent or poorly demarcated. Wing with a small to large patch of pale scales basally on the costa (although entirely absent on the specimen from Frobisher Bay). Larval-associated specimens seen from: Ft. Chimo and Great Whale River, Quebec; Frobisher Bay, Baffin Island; and Umiat, Alaska. These localities are all above tree line except Great Whale River which lies within the transition zone.

The torus is usually dark and the mid femur usually has a few to many scattered pale scales anteriorly in both varieties.

Male.—Genitalia identical with those of *punctor*. Figure 5.

LARVA. *Head* (Fig. 7): Hairs 5 and 6 single to triple, hair 7 with 2–8 branches. *Abdomen* (Fig. 8): Dorso-lateral hair of segments I and II single to triple. Lateral hairs of I–VI single to triple, of II rarely with 4–6 branches. Comb consisting of a row of 5–9 (rarely 10 on one side) large teeth. Anal plate ventrally complete from immediately basad of the ventral brush. Dorsal pair of anal gills 1.4–3.6 times as long as the anal plate.

As with *punctor*, it appears that a significant larval correlation exists with the two varieties described from the adult stage. In "type

hexodontus" variety, head hair 5 is 100% double and hair 6 is 78–100% double; whereas, in "tundra" variety hair 5 is 0–17% double and hair 6 is only 0–7% double. In contrast *punctor* has head hair five 25–50% double regardless of the geographical locality.

DISTRIBUTION. As with *punctor* only records based on larvae and larval-associated adults are given.

ALASKA: Knight collection. 11 males and 5 females, with associated larval and pupal skins, Umiat (Knight, Schultz). U.S.N.M. (all collected by members of the 1947 Alaska Mosquito Project). 6 males, with associated skins, from the following localities: Valdez-Fairbanks (MP–23, MP–131, MP–148) and Glenn Hwy (MP–35).

CANADA: U.S.N.M. 3 males, 5 females, 14 larval skins, Prince Rupert, British Columbia (Dyar). 1 female, with larval skin, Kwinitsa, British Columbia (Dyar). C.N.C. 1 male and 1 female, with larval skins, Frobisher Bay, Baffin Island, Northwest Territories (Freeman). 1 female, with larval skin, Ft. Chimo, Quebec (MacLeod). 7 males and 6 females, with larval skins, Great Whale River, Quebec (Jenkins, Knight).

UNITED STATES: U.S.N.M. 1 female, 3 larval skins, Fallen Leaf Lake, Lake Tahoe, California (Dyar). 1 female, 6 larval skins, Tahoe Tavern and Lake Tahoe, California (Dyar). 2 males, 5 females, 8 larval skins, Truckee, California (Dyar). 1 male and 3 females, with larval skins, Grand Lake, Colorado (Dyar). 1 male, with larval skin, North Fork Ranger Station, Glacier National Park, Montana (Dyar).

DISCUSSION. The male of *hexodontus* is distinguishable on the basis of genitalia from *punctodes* and *implacabilis*, but not from either *punctor* or *aboriginis*. Although intergradation occurs, the female of "type *hexodontus*"variety is generally distinguishable from its counterpart in *punctor* ("type *punctor*" variety) by having a distinct patch of pale scales basally on the costa, an all-dark torus, and few to many scattered pale scales anteriorly on the mid femur. The female of "tundra" variety of *hexodontus* is generally distinct from that of "tundra" variety of *punctor* by the first and last characters mentioned just above, the torus usually being all dark in both. The larva of *hexodontus* is distinct from that of all the other species except that an occasional specimen has been seen with 10 comb teeth on just one side, and it is to be supposed from this that a specimen with 10 teeth on both sides could undoubtedly be encountered if the series of specimens were large enough.

When larvae of the *hexodontus* type were first found outside the well-established Montana-Colorado-California-British Columbia range (and mixed with *punctor* collections), some doubt was felt that *hexodontus* could any longer be considered even a valid subspecies (since apparently no isolation of any form existed). However, at Umiat, Alaska where the

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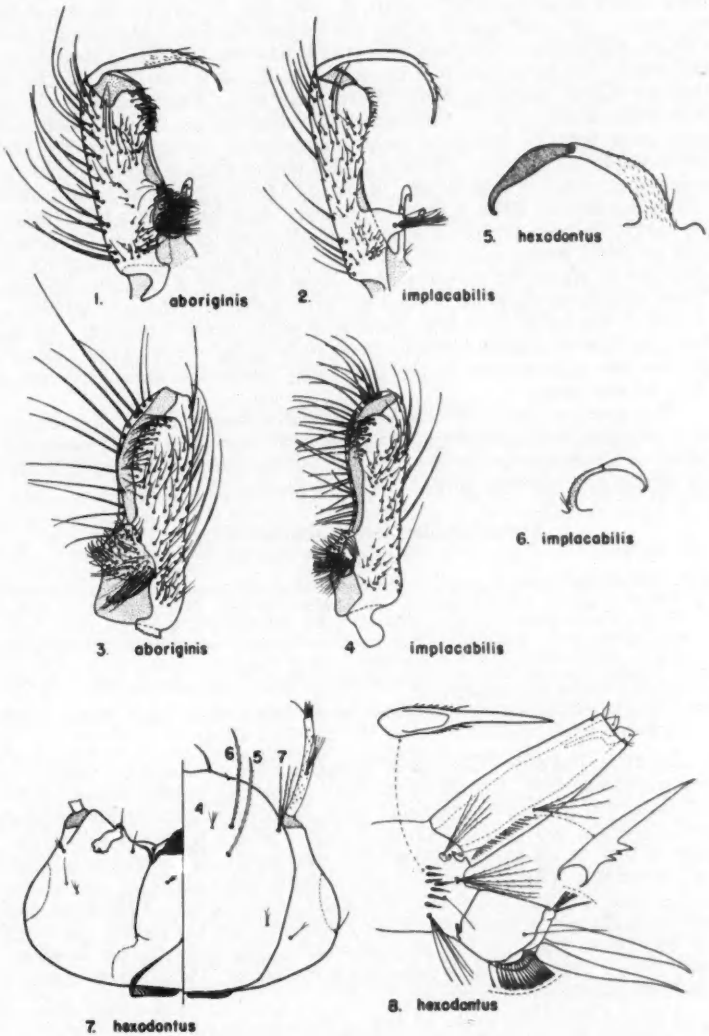
EXPLANATION OF PLATE I

FIG. 1. Tergal aspect of left basistyle. Prince Rupert, B. C. FIG. 2. Tergal aspect of left basistyle. Volo, Ill. FIG. 3. Inner tergal aspect of right basistyle. West Holme, B. C. FIG. 4. Inner tergal aspect of right basistyle. Volo, Ill. FIG. 5. Lateral aspect of claspette. Umiat, Alaska. FIG. 6. Lateral aspect of claspette. Volo, Ill. FIG. 7. Larval head. Left side ventral aspect. Umiat, Alaska. FIG. 8. Lateral aspect of larval terminal segments. Umiat, Alaska.


1. aboriginis
2. implacabilis
5. hexodontus
3. aboriginis
4 implacabilis
6. implacabilis
6
5
7
4
7. hexodontus
8. hexodontus

author had the opportunity of making quite extensive studies in a small area for two seasons, it was noted that ***punctor*** and ***hexodontus*** larvae were found in almost pure cultures, with the latter by far the most common. The only spot in which the former was found abundantly was a single sphagnum-heath pool area, which otherwise bred only ***nearcticus***. Otherwise the larvae of ***punctor*** were found very sparingly scattered through *Carex* marshes which were supporting huge populations of ***hexodontus*** and ***nigripes***. Because of this observation, it is now believed that some form of ecological isolation probably occurs where the two forms exist side by side. In view of this and of a similar situation found to occur at Great Whale River, Quebec by D. W. Jenkins and the author in the summer of 1949, I have maintained ***hexodontus*** as a full species. However, because of the intergradation that occurs between ***hexodontus*** and ***punctor*** it seems quite likely that they will eventually be found to be varieties or races, or no more than subspecies, of a common species. Much additional data are needed before this can be definitely settled.

All of the types have been seen and lectotypes established. It has been possible to confirm Gjullin's synonomy of ***cyclocerculus*** and ***leuconotips*** by the examination of the previously unlocated associated larval skins of the types.

This species has not yet been specifically described from the Palaearctic Region, but the fact that Natvig (1948) describes eight Norwegian larvae of his ***punctor*** material as having less than 10 comb teeth indicates the probable occurrence of ***hexodontus*** in northern Europe.

Aedes (Ochlerotatus) aboriginis Dyar

Figs. 1 and 3

1917. *Aëdes aboriginis* Dyar, Ins. Insc. Mens. 5: 99 (males, females, larvae). TYPE-LOCALITY: United States. Longmire Springs, Mt. Rainier National Park, Washington (Dyar). TYPE: 1 male (18-VI-17), 1 female (17-VI-17) (cotypes) in the U.S.N.M. The male specimen is here designated as lectotype. Male genitalia not separated.

1921. *Aëdes* (*Heteronycha*) *aboriginis* Dyar. Dyar, Trans. Royal Canad. Instit. 13: 98. Different combination.

1921. *Aëdes* (*Ochlerotatus*) *aboriginis* Dyar. Dyar, Ins. Insc. Mens. 9: 73. Different combination.

ADULT. *Female.*—Torus pale laterally, dark medially (all brown in two specimens from British Columbia). Scutum yellow, marked with a dark brown median longitudinal band (may be longitudinally divided medially by a thin line or stripe of pale scaling), a paired submedian longitudinal dark area usually present posteriorly, the prescutellar area and scutellum with scales of a paler shade than those of the scutal background pattern. In one specimen from British Columbia the background color of the scutal scaling is brown and the darker markings are blackish-brown. Wing all dark-scaled; the type female however with a very few pale scales basally on the costa. Mid femur without scattered pale scales anteriorly.

Male.—Genitalia as figured (figs. 1 and 3).

LARVA. *Head:* Head hair 5 with 4–6, rarely 3–7, branches; 6 with 2–4; 7 with 6–9, once with 12. *Abdomen:* Dorso-lateral hair of segments I and II double, triple on II in one specimen. Lateral hair on I single, once double; on II double, occasionally single; on III–VI double. Comb consisting of a patch of 23–39 scales, each scale with a lateral and apical

fringe, 1–3 of the apical fringe elements stouter and longer than the others. Anal plate narrowly incomplete ventrally. Dorsal pair of anal gills 2.9 (one specimen only) as long as the anal plate.

DISTRIBUTION. Only records based upon larvae or upon larval-associated adults are given.

CANADA: U.S.N.M. 5 females, 9 larval skins, Prince Rupert, British Columbia (Dyar). 3 females, 3 larval skins, Kwinitsa, British Columbia (Dyar).

UNITED STATES: U.S.N.M. 3 males, 4 females, 10 larval skins, Longmire Springs, Mt. Rainier National Park, Washington (Dyar).

DISCUSSION. Whether or not the range of "type ***punctor***" variety overlaps that of ***aboriginis*** is not known at present, but the females of the two are apparently indistinguishable. The male is indistinguishable from that of ***punctor*** and ***hexodontus***. The larva is distinct from all the others by the combination of the following characters: the number of branches of head hairs 5 and 6, the number and form of the comb scales, and the incomplete anal plate.

The type series has been studied.

Aedes (Ochlerotatus) punctodes Dyar

1919. *Aëdes* (*Ochlerotatus*) sp., Dyar, Rept. Can. Arctic Exp. 3, Part C, p. 33.
1922. *Aëdes punctodes* Dyar, Ins. Insc. Mens. 10:1 (males, females). TYPE-LOCALITY: Alaska. Valdez (Aldrich). Anchorage (Aldrich). Unalakleet (Hadwen). TYPE: 7 males (cotypes) in U.S.N.M., all with genitalia separated. Male #1582 from Unalakleet is here designated as lectotype. One of the cotypes from Unalakleet proved to be *punctor*.
1922. *Aëdes* (*Heteronycha*) *punctodes* Dyar. Dyar, Proc. U. S. Nat. Mus. 62: 55. Different combination.
1928. *Aëdes* (*Ochlerotatus*) *punctodes* Dyar. Dyar, Mosq. Amer., p. 180. Different combination.

ADULT. *Female.*—Torus usually paler laterally. Scutum brown scaled, often yellowish-brown scales laterally, more rarely with a narrow pair of median darker longitudinal bands; the scales over the wing base, on the prescutellar area, and on the scutellum yellow or whitish. Wing dorsally all dark, frequently a very few pale scales basally on the costa. Mid femur with few or no scattered pale scales anteriorly.

Male.—Male genitalia as in figures 2, 4, and 6 (***implacabilis***).

LARVA. *Head:* Hair 5 with 1–2 branches, 6 single, 7 with 3–5. *Abdomen:* Dorso-lateral hair of segments I and II with 1–2 branches. Lateral hair of I single; of II single, rarely double; of III–VI with 1–2, once triple, with at least one 2-branched hair on each larva except in one specimen where they were all single (the associated adult of this specimen is a female so that the identification cannot be definitely established). Comb consisting of 10–16 teeth. Anal plate narrowly incomplete ventrally. Dorsal pair of anal gills 0.80–1.4 as long as the anal plate; 13 of the 17 specimens examined had the dorsal gills equal to, or shorter than, the anal plate.

DISTRIBUTION. Only records based upon male genitalia and larval-associated adults are given.

ALASKA: U.S.N.M. Type series from Valdez, Anchorage, and Unalakleet. 5 males, 9 females, with larval skins, Anchorage (Alask. Mosq. Proj.). 1 male, with larval skin, Anchorage-Palmer, MP–16 (Alask. Mosq. Proj.). 3 males, with larval skins, Valdez (Alask. Mosq.

Proj.). 1 female, with larval skin, Eklutna (Alask. Mosq. Proj.). 4 males, Matanuska (Chamberlain).

DISCUSSION. For a number of years, this species has been treated as a synonym of ***punctor***, but a study of the larval-associated adults listed above that were collected by the members of the 1947 Alaska Mosquito Project has shown it to be a distinct species.

The male genitalia are indistinguishable from those of ***implacabilis*** but are readily so from those of ***punctor***, ***hexodontus***, and ***aboriginis*** on the shape of the basal lobe. The female is not distinct from the "tundra" variety of ***punctor***, or the "tundra" variety of ***hexodontus***, both of which are known to overlap the range of ***punctodes***. The larva is distinct from all the other species of the subgroup on the combination of the number of branches of head hairs 5 and 6 and of the lateral hairs of abdominal segments III–VI, the number of comb teeth, the open anal plate, and the short anal gills. However, an occasional ***punctor*** larva is found in the Fairbanks-Anchorage area which intergrades with the larva of ***punctodes***. It is an interesting fact that equivalent ***punctor*** specimens have not been seen from outside the range of ***punctodes***.

Since ***punctodes*** was not recognized at the time the field work of the 1947 Alaska Mosquito Project was being done, no specific notes are available on its biology. However, all the collections came from ***Carex*** marshes. Also, they frequently contained both typical and atypical ***punctor***.

The present known distribution of this species indicates that it is endemic to the coastal region of Alaska, with extensions up the larger river valleys.

Aedes (Ochlerotatus) implacabilis (Walker)

Figs. 2, 4, and 6

1848. *Culex implacabilis* Walker, List Dipt. Brit. Mus. 1: 7 (female). TYPE-LOCALITY: Canada. St. Martin's Falls (now Martin Falls), Albany River, Hudson's Bay, Ontario (Barnston). TYPE: Female (holotype) in British Museum. Identified as type by Waterhouse.

1904. *Culex absorratus* Felt and Young, Science, n.s., 20: 312 (adults, larvae). TYPE-LOCALITY: United States. Elizabethtown, New York (Felt and Young). TYPE: No information. Presumably in the New York State Museum, Albany.

1917. *Aëdes centrotus* Howard, Dyar, and Knab, Mosq. N. and Cent. Amer. and W. I. 4: 747 (30 females). TYPE-LOCALITY: Canada. White River, Ontario (Knab). TYPE: 14 females (cotypes) in U.S.N.M. The other 16 females represent another species. A female specimen from the series of 14 is here designated as lectotype.

1921. *Aëdes (Ochlerotatus) dysanor* Dyar, Ins. Insc. Mens. 9: 70 (males). TYPE-LOCALITY: United States. Plattsburgh, New York (Dyar and Hudson). TYPE: Male (holotype) in U.S.N.M. Paratypes: 6 males, Dublin, N. H. (Busck); 2 males, Saxeville, Wisc. (Miller); 1 male, Ft. Ethan Allen, Vt. (Ludlow); 1 male, Ft. Strong, Mass. (Schott). All genitalia separated.

1924. *Aëdes implacabilis* Walker. Dyar, Ins. Insc. Mens. 12: 26. Synonomy of *absorratus*, *centrotus*, and *dysanor*.

ADULT. *Female.*—Torus usually paler laterally. Scutum yellowish-brown scaled, a broad longitudinal median area with reddish-brown scaling, pale scaling over the wings and on the prescutellar area. The Dublin specimens have the background brownish-yellow, and one Volo specimen has it pale yellow. In these specimens, the reddish-brown median band is rather more distinct. Wing dorsally all dark-scaled. Mid femur with few or no scattered pale scales anteriorly.

Male.—See figures 2, 4, and 6 of the male genitalia.

LARVA. Similar to ***punctor***, differing mainly as follows: comb consisting of a row of 5–7 prominent teeth. *Isc* single, similar to *osc* in development.

DISTRIBUTION. Since the male genitalia of this species are indistinguishable from those of ***punctodes***, records from the male alone must be viewed with some caution. However, it is believed that the ranges of the two species are not confluent, and consequently records from males, larvae, and larval-associated adults are given.

CANADA: C.N.C. 2 females, larval skins, Goose Bay, Labrador (Friesen). U.S.N.M. 2 males, White River and Dryden, Ontario (Dyar).

UNITED STATES: U.S.N.M. 7 males, 3 females, with associated larval skins, Dublin, New Hampshire (Busck). 1 male, Ft. Ethan Allen, Vermont (Ludlow). 1 male, Plattsburgh, New York (Dyar and Hudson). 1 male, Ringwood, New York. 1 male, Ithaca, New York. 1 male, Ft. Strong, Massachusetts (Schott). 1 male, Fall River, Massachusetts. 7 males, Kingston, Rhode Island (Knutson). 2 males, Saxeville, Wisconsin (Miller). 1 male, Ely, Minnesota. 1 male, Volo, Illinois (Ross).

DISCUSSION. The male genitalia are distinguishable from all the others except ***punctodes***. On the basis of the descriptions given in this paper, the female is indistinguishable from that of "type ***punctor***" variety, "type ***hexodontus***" variety, and ***aboriginis***. However, when one is familiar with the fine reddish-brown median scutal scaling typical of ***implacabilis***, the female is apparently always recognizable. The larva is distinct from all of the others because of *isc* being single.

The type series of ***centrotus*** consists of 30 females. Fourteen of these specimens match my concept of ***implacabilis***. The other sixteen are all without a scale patch in the area between the fore coxa and the sternopleuron and are accordingly some other species.

All of the type series of ***dysanor*** except specimen 486 from Dublin have been examined by me and are all ***implacabilis***.

The type of ***abserratus*** has not been seen by me.

P. W. Mattingly, British Museum (Natural History) kindly examined the type of ***implacabilis*** and reports that the single female specimen is in very poor condition. The legs are missing, the dorsal surface of the abdomen is rubbed, and there is a large pin through the middle of the scutum. Since the scutal pattern of the female offers the only opportunity for definitely recognizing this species, the exact identity of the type will probably remain in question.

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CLIMACIA AREOLARIS (HAGEN) PARASITIZED BY A NEW PTEROMALID

(Hymenoptera: Chalcidoidea)

I. Description of the Parasite

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Specimens of what appear to be a new genus and new species of Pteromalidae have been received for identification from Dr. Harley P. Brown, of the University of Oklahoma. They were observed by him parasitizing nymphs of the neuropteroid, *Climacia areolaris* (Hagen), at Put-in-Bay, Ohio, during July 1949. A description of the new parasite follows.

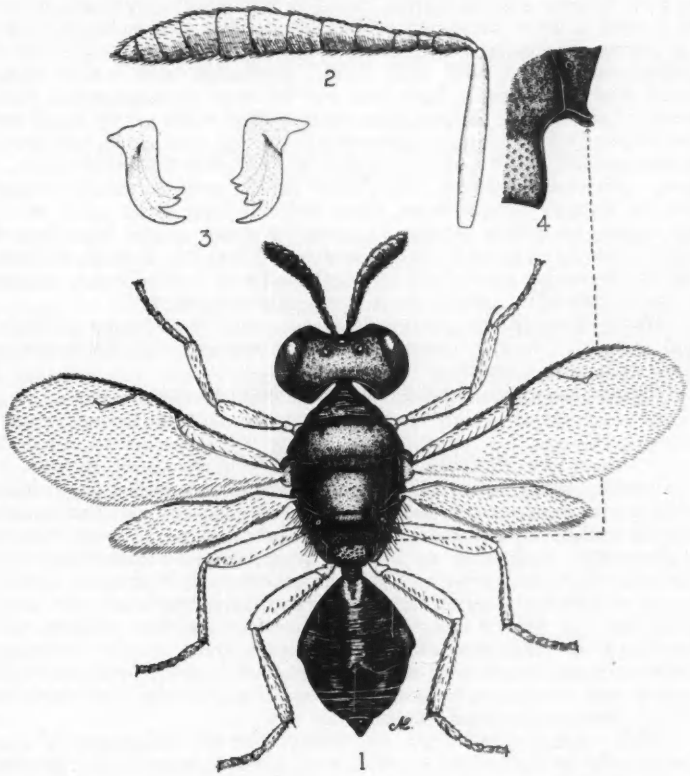
Family **Pteromalidae**

Sisyridivora new genus

This genus bears a striking, though superficial, resemblance to *Eupteromalus* Kurdjumov. It differs from *Eupteromalus* by having the abdomen much more distinctly petiolate; by having a distinct transverse furrow at about the apical one-fourth of scutellum; by having the left mandible three-toothed, the right four-toothed; by having the antennae inserted below the middle of face, about on a line with the lower extremities of the eyes; and by having the clypeus roundly produced apically, somewhat as in the genus *Tridymus*. These characters place the genus in the tribe *Sphegigasterini* rather than in the Pteromalini where *Eupteromalus* is placed. Among the *Sphegigasterini* it most closely resembles *Gyrinophagus* Ruschka but is distinguished at once by the fact that the occiput is distinctly carinately margined and by the presence of the transverse furrow on the scutellum.

Female.—Head, viewed from above, as wide as thorax at tegulae, nearly three times as wide as thick; temples receding; vertex broad; occiput narrowly concave and distinctly margined, the carina some distance below vertex; eyes bare; ocelli in a low triangle, the ocellocular line nearly as long as the postocellar line; head, viewed from in front, very slightly broader than high, subcircular in outline; anterior margin of clypeus rounded and slightly produced, base of clypeus not defined, the clypeal foveae present but no trace of a connecting groove; left mandible tridentate, right quadridentate, the teeth rather long and acute; maxillary palpus with four segments, labial palpus with three segments; cheek with a triangular excavation extending from base of mandible to lower margin of eye; antennae inserted about on a line

with lower extremities of eyes; scrobes not deep, immargined, and extending to anterior ocellus. Antennal scape subcylindrical, not quite reaching anterior ocellus; flagellum twice the length of scape; pedicel a little over twice as long as thick, equal to one-fourth length of scape; first ring-segment nearly twice as broad as long, second subquadrate;



Sisyridivora cavigena Gahan. FIG. 1. Adult female. FIG. 2. Antenna of female. FIG. 3. Mandibles. FIG. 4. Detail of propodeum. All much enlarged. Illustrations by Addie M. Egbert.

funicle thicker than pedicel, six-segmented; first and second funicular segments subequal and each distinctly a little longer than broad; third, fourth and fifth segments subquadrate, the sixth a little broader than long; club three-segmented, not broader than last funicular segment, conic-ovate and somewhat longer than two preceding segments combined. Thorax not slender; prothorax short, conical; dorsal aspect of

pronotum transverse-linear, much below level of mesoscutum and with a distinct marginal carina; mesoscutum convex, about three times as broad as long; parapsidal grooves absent except for a short distance at each antero-lateral angle; axillae well separated; scutellum subconvex, about as long as mesoscutum, with a deep transverse furrow at about the apical one-fourth; propodeum rather long, with a large subglobose neck, a distinct median carina basad of the neck, cariniform lateral folds, and a short tooth-like projection at each postero-lateral angle just above the insertion of posterior coxae; spiracles elliptical; sides of propodeum clothed with long hairs. Forewings with rather dense discal cilia except for a bare area behind most of submarginal vein; marginal cilia short; marginal and postmarginal veins nearly equal and each about half as long as submarginal; stigmal vein about two-thirds as long as marginal. Legs rather slender, posterior tibia with only one spur. Abdomen petiolate, the petiole nearly smooth, rather slender, broader at apex than at base, about twice as long as its apical width and about two-thirds as long as posterior coxae; gaster boat-shaped, approximately equal to thorax in length and breadth, smooth, its basal tergite comprising nearly half its length and with a small notch or sinus in the middle of its apical margin; ovipositor not exserted.

Male.—Exactly like the female except that the abdomen is shorter and narrower than the thorax and the first segment of gaster comprises more than half its length.

Type of the genus, the following described new species.

Sisyridivora cavigena new species

Female.—Length 2.85 mm. Head and thorax, including propodeum, with dense reticulate, punctate sculpture, only the cylpeal area on head weakly sculptured and more or less shining; abdomen almost entirely sculptureless, with only some weak reticulation on apical sternites. General color black with a slight coppery tinge on dorsum of thorax; scape, mandibles, anterior and median legs (including their coxae) and posterior legs (except coxae), reddish testaceous; the posterior and median tibiae and sometimes their femora more or less brownish; abdominal petiole and most of gaster black, but the gaster with a rounded yellow area at extreme base covering less than half the basal segment. Wings hyaline; venation fuscous.

Male.—Length 2.25 mm. Abdomen shorter and narrower than thorax, the gaster ovate in outline. Otherwise exactly as described for the female.

Type.—Female, United States National Museum No. 59341.

Described from 4 ♀s and 8 ♂s reared by Prof. Harley P. Brown, of the University of Oklahoma, from nymphs of ***Climacia areolaris*** (Hagen) collected at Put-in-Bay, Ohio, in July 1949.

CLIMACIA AREOLARIS (HAGEN) PARASITIZED BY A NEW PTEROMALID

(Hymenoptera: Chalcidoidea)

II. Life history of the parasite[1]

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Climacia areolaris (Hagen) and *Sisyra vicaria* Walker are the only North American representatives of the neuropterous family Sisyridae (Navás, 1935). Since all known sisyrid larvae feed upon freshwater sponges, the distribution of sisyrids is dependent upon the distribution of their sponge hosts. The work upon which this article is based was done at the Franz Theodore Stone Laboratory, which is located upon an island in the western portion of Lake Erie. Both *Climacia* and *Sisyra* occur in this area, the former parasitizing *Spongilla fragilis* Leidy in the waters of the lake, whereas the latter parasitize the same host, but in the waters of shallow ponds on the islands. *Climacia*, which is abundant in the immediate vicinity of the laboratory, was studied in a desultory fashion during the summers of 1941, 1942, 1944, and 1945, and was studied intensively during the summer of 1949 (Brown, in press). As early as 1941, small, black chalcidoid wasps were observed and collected in the act of stinging or ovipositing upon the inhabitants of *Climacia* cocoons (Brown, 1942), although it was not until the summer of 1949 that specimens were sent to Mr. A. B. Gahan, of the U. S. Dept. of Agriculture, for identification. As indicated in Part I of the present paper, Mr. Gahan considers the hymenopteron sufficiently distinct from related forms to justify the erection of a new genus for this new species, the name he applies being *Sisyridivora cavigena*. Individuals of this species, or related species, have undoubtedly been collected by other investigators, since both Old (1932) and Withycombe (1922) refer to hymenopterons emerging from sisyrid cocoons. Old's work was done in the vicinity of Douglas Lake, Michigan, where he found both *Climacia* and *Sisyra*. I gather, from this paper, that cocoons of both genera yielded these hymenopterons, although he did not specifically state this to be the case. Withycombe's work concerned the British species, *Sisyra fuscata* and *S. terminalis*. The observations of these two authors would suggest that *Sisyridivora* probably parasitizes both *Climacia* and *Sisyra*, although my own observations were restricted to *Climacia*—hence only this genus is mentioned by Mr. Gahan in his introduction.

[1]Contribution from the Franz Theodore Stone Laboratory, Put-in-Bay, Ohio.

MATERIALS AND METHODS

Adults were obtained in three ways: (1) direct field collection, (2) rearing from host cocoons collected in the field, (3) rearing from egg to adult in the laboratory.

Thirty adults were reared from eggs deposited in the laboratory. A number of eggs, larvae, and pupae were preserved at different stages of development. Most of the immature specimens were killed either in hot water or in K. A. A. D. solution (1 part kerosene, 10 parts 95% ethyl alcohol, 2 parts glacial acetic acid, 1 part dioxane) and preserved in 95% alcohol.

Rearing was accomplished in Petri dishes, either standard or small. A moistened bit of gumdrop served to keep the adults alive for several days.

Host (*Climacia*) cocoons which had been spun directly upon the glass of the Petri dishes were most satisfactory for purposes of observation, since eggs, larvae, etc., could be seen through the cocoon with a properly adjusted source of transmitted light.

Courtship, mating, oviposition, etc., were observed at magnifications ranging from 1 to 100X, 15–45X being most generally useful.

RESULTS AND DISCUSSION

Adult

The adults of *Sisyridivora cavigena* are adequately described in Part I, by Mr. Gahan, so I need add nothing here concerning their morphology. However, I might point out that the size of the individuals varies considerably, some exhibiting more than twice the bulk of others in the same brood. The difference appears to be correlated with the amount of food available to the developing larva. In addition to obvious variations in host size, a significant factor is introduced when two or more wasp larvae, instead of the customary *one*, must feed upon a single host.

Adults were collected throughout July and August. They are probably present and active, however, from spring to fall. In fact, they probably over-winter in the adult stage, whereas their hosts probably overwinter as larvae upon sponges. Wherever *Climacia* cocoons occur in reasonable numbers, *e.g.*, one per square foot, *Sisyridivora* is likely to be found. Since cocoons of the host (*Climacia*) are locally abundant, sometimes as many as 100 being clustered within a square foot, it is not surprising to find that as many as 15 adult wasps have been collected at one time within an area of one square yard. Such a concentration, however, is extremely unusual.

When engaged in seeking or working upon host cocoons, the wasps seem quite intent upon their business, and may even be examined through a hand lens without being noticeably disturbed. During their normal activities, they seldom take flight; instead, they hurry about over the substrate, investigating every object encountered by means of their antennae. Neither a migrating larva nor an exposed pupa nor an adult of the host species appears to arouse any interest on the part of a wasp, but a cocoon of the host excites immediate enthusiasm, at least in the female. Upon discovering a *Climacia* cocoon, or the net

covering such a cocoon, the female wasp explores the entire surface of the net and as much of the inner cocoon as she can reach with her vibrating antennae. If the cocoon is empty or very old, she will usually abandon it shortly. If it is reasonably fresh, however, she soon begins to probe it here and there with her ovipositor and commonly selects, by trail and error, that part of the net which lies closest to the inner

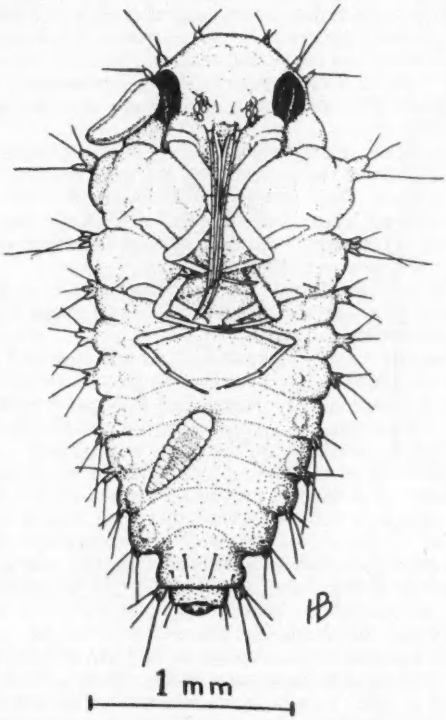

FIG. 1. Egg and newly-hatched larva of *Sisyridivora* upon pre-pupal *Climacia* larva. The egg lying beside the eye of the host has not yet hatched, having been deposited less than an hour earlier. The larva upon the abdomen of the host has begun feeding, as may be seen by its darkened gut.

cocoon. Movement of the host larva or pupa within the cocoon may be one of the stimuli causing the wasp to initiate stinging, although other tactile and/or chemical stimuli must be involved, since she does not continue her activity if the cocoon contains a shriveled dead host or a well-developed grub or pupa of her own species. The presence of an egg or a very young grub upon the paralyzed host does not always

"discourage" the probing female; thus a second, or even a third egg may be deposited upon a single host, though not at the same laying.

If the host is satisfactory—and any stage of *Climacia* from newly-spun larva to pre-emergent pupa seems satisfactory—the female wasp inserts her ovipositor in the wriggling host (Fig. 8) and proceeds to pump venom into it for a minute or longer. After it has become quiescent, she withdraws her ovipositor, then shifts position slightly before reinserting the ovipositor through net and cocoon to deposit an egg upon the host. At times, several minutes may be consumed in the process of oviposition proper. In some cases, the female is unable to extricate her abdomen from the mesh of the net, and remains thus trapped to die. Some females get caught in this manner without ever managing to reach the host larva, and so are doomed to frustration as well as death.

One female, after finally withdrawing her ovipositor, placed her mouthparts at the site of the puncture on the inner cocoon (the net being closer to the cocoon than usual). She remained motionless in this position for several minutes, even though I jiggled the cocoon by means of a fine needle. Just what significance this behavior might have, I do not know. She was not feeding.

The activities of the female, as described above, apply equally to virgin wasps and to those which have mated, although the latter seem a bit more business-like and persistent.

Adult males are even more restless than females, and appear to be constantly on the prowl. Upon approaching or encountering a female, the male immediately evinces interest and amorous intent. If engaged in stinging or ovipositing, the female repulses her admirer by vibrating her antennae rapidly while extending them toward him. She may also utilize her mandibles in dissuading him. If not so engaged, she may repulse him anyway, if she has previously mated, or she may passively accept his advances, or she may seemingly ignore him as he pursues her hither and yon. If she remains passive and motionless, he approaches her with his antennae folded anteriorly and rapidly vibrating, his body swinging or shaking from side to side, and his wings whirring intermittently. Then he moves behind her, places his forelegs upon her wings while his four remaining legs are on the substrate. Now, without moving any of his feet, he moves his body forward above hers with a jerky zigzag motion, his antennae being rigidly extended laterally. Upon reaching a point at which his head is above her prothorax, he retreats to the rear position, then repeats the entire process. This may be kept up for several minutes before copulation is attempted. In copulation, the male is posterior to the female, with the long axis of his body almost vertical, except for the tip of his abdomen, which is directed anteriorly, contacting her genitalia. In the course of a day or so, one male may mate with several females.

The only predators observed feeding upon *Sisyridivora* were orb-weaving spiders, whose webs are abundant in areas where concentrations of *Climacia* cocoons occur.

Egg

The egg (Figs. 1, 2) is a little over 0.4 mm. in length and about 0.15 mm. in width at the broadest point. It is broadest near the micro-

pylar end, tapering gradually to a blunt point enclosing an air space at the opposite end. Since one side is convex, the other slightly concave, there is a crude resemblance to a comma or to a top-heavy banana. A reticulation is apparent on the convex side of the egg; I am not certain whether this appearance is due to the presence of crowded globules within the egg or to markings on the chorion, although I strongly suspect the latter.

The egg is glistening, translucent, and whitish. Its outer surface is somewhat sticky, causing it to adhere to that part of the host upon which it is deposited.

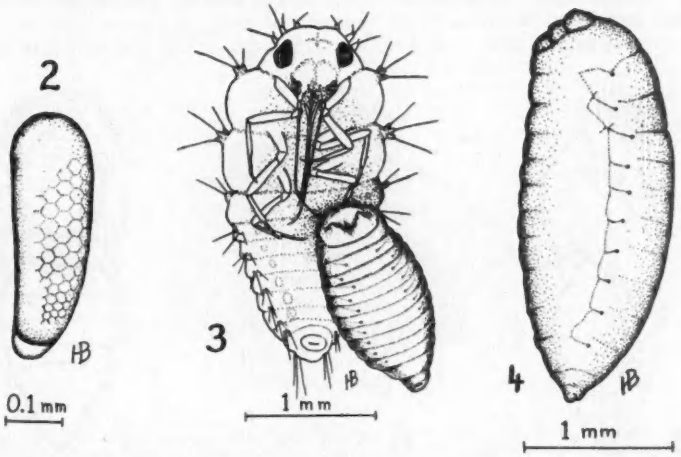

FIG. 2. Egg of *Sisyridivora cavigena*. FIG. 3. Half-grown larva of *Sisyridivora* feeding upon pre-pupal *Climacia* larva. *Sisyridivora* in dorsal aspect. FIG. 4. Full-fed pre-pupal larva of *Sisyridivora*, lateral aspect.

Hatching may occur within 24 hours after oviposition. A few eggs fail to hatch; whether death is due to action of bacteria or fungi, or to some other factor, I do not know.

Larvae

The newly-hatched larva (Fig. 1), which is about the size of the egg, is similar in general appearance to the older larvae, as described below. It differs slightly in that the segments are more clearly demarked, the body is completely whitish and translucent, and, of course, it is smaller.

The prepupal larva (Fig. 4) is about 2.5–3.0 mm. in length, and about 1.0 mm. in greatest width (near the middle of the body). It is turgid with food, and the abdominal segments, in particular, are difficult to distinguish. The head bears a pair of antero-dorso-lateral papillae which are probably sensory in function. The mouth is ventral, and is hidden by thick, fleshy lips. A slight constriction separates the thorax

from the abdomen. The anterior abdominal segments are broader than the thoracic segments. The overall body shape is fusiform, except for the broadly-rounded head. Spiracles and tracheal tubes are perceptible in the meso- and metathorax and in the first eight abdominal segments. The spiracles are located on the dorso-lateral surfaces, and are seen to be connected with the longitudinal tracheal trunks. Just beneath the epidermis, embedding much of the tracheal system, is a layer of translucent whitish globules, the globules averaging 85 to 90μ in diameter. Internal to this layer, and apparently covering the surface of the bulging gray-green gut, there are smaller white bodies about 20 to 40μ in diameter. The larva is rather inactive, but its viscera are constantly churning, with peristaltic waves passing alternately backward and forward.

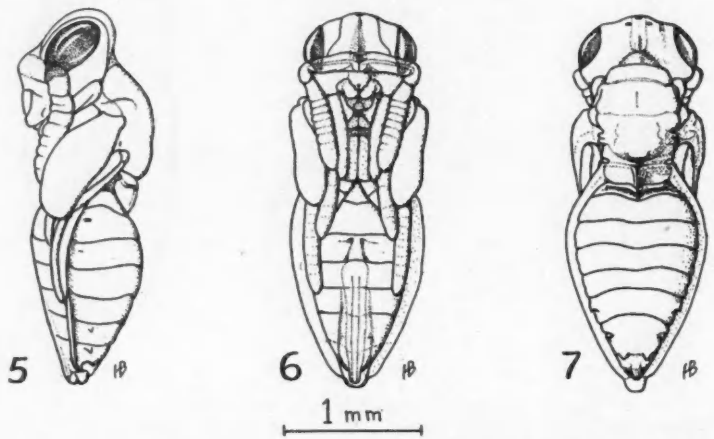

FIG. 5. Pupa of *Sisyridivora*, on the third day of pupation. Lateral aspect. FIG. 6. Pupa of *Sisyridivora*, on third day of pupation. Ventral aspect. FIG. 7. Pupa of *Sisyridivora*, on third day of pupation. Dorsal aspect.

The larva feeds with its lips applied to the body of the host, pumping or sucking its contents out while the skin of the host shrivels to a mummy (Fig. 3). As would be expected, a larval host skin shrinks more than a pupal host skin, the shrunken pincushion of a *Climacia* larva being less than half the length of the full-fed *Sisyridivora* grub. No defecation occurs until the contents of the host have been completely ingested, then, prior to pupation, large, glistening, black, multi-lobed fecal pellets are produced.

I did not determine the number of larval instars. No sclerotized parts were accessible for measurements. The only larval ecdysis observed was that involved in pupation. The cast skins from full-fed larvae were the only larval skins observed.

Pupation occurs between 4 and 10 days after hatching, the time varying in relation to such factors as temperature and quantity of food available.

Normal larvae develop from unfertilized eggs. It is of interest to note that parthenogenesis may occur normally, even though the adult sex ratio is approximately 1:1, and a definite courtship pattern exists.

I suspect that cannibalism may occur when several larvae develop within a single cocoon; however, I made no critical observations on this point.

Pupa

The pupa (Figs. 5, 6, 7) is 2.5 to 3.0 mm. in length, and about 1.0 mm. in width across the eyes, wings, and third abdominal somite. The general features of the adult are recognizable. The antennae extend

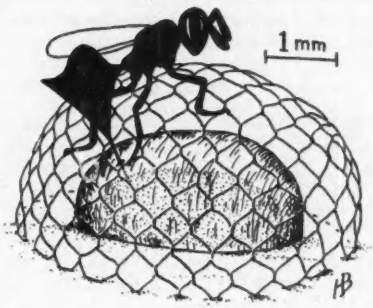

FIG. 8. Adult female *Sisyridivora* ovipositing upon *Climacia* larva or pupa (semi-diagrammatic). The ovipositor extends through the net and cocoon, reaching the host within.

transversely across the posterior portions of the eyes, then elbow posteriorly and slightly medially, terminating near the posterior margin of the thorax. The wing pads extend to the posterior margin of the first abdominal somite. The tips of the prothoracic legs reach the posterior margin of the thorax, those of the mesothoracic legs reach the posterior margin of the second abdominal somite, and those of the metathoracic legs reach the posterior margin of the fourth abdominal somite. The ovipositor is discernible along the mid-ventral line of the abdomen in the female. A flattened flange about 0.1 mm. wide extends the entire length of the abdomen on each side, slightly ventral to the mid-lateral line. A small conical projection, directed posteriorly, occurs on the dorso-lateral surface of each side of the sixth and seventh abdominal somites.

Upon shedding the larval skin, the pupa is light in color, ranging from ivory to amber. Within three days, the ocelli and eyes have turned red-brown. By the fourth day, the head and thorax have darkened to a deep brown; the eyes and ocelli are black. By the fifth

day, only the ventral portion of the abdomen remains light in color. On the sixth day, the pupa is entirely dark, and emergence occurs during the evening. These figures apply to female pupae more precisely than to males, the latter developing a little more rapidly.

After shedding the pupal skin, the adult rests for some minutes while the skin is hardening. Then it begins pushing with its hind legs against one wall of the host cocoon, and with the elbows of its antennae—scape directed anteriorly—against the opposite wall. Later, it begins chewing the cocoon wall. What with intermittent chewing, pushing, and resting, it may be several hours before the adult actually escapes through neatly-cut holes in the cocoon and net.

After emerging, before leaving the vicinity of the host cocoon, the adult deposits several drops of cream-colored fecal matter. Also in the neighborhood of the cocoon there is left a small, brown, cigar-shaped object which I never saw being produced. I do not know what it is.

The total time required for development from egg to adult ranges from 9 to 15 days, the males of a given brood emerging a day or so earlier than the females of the same brood.

SUMMARY

Sisyridivora cavigena Gahan was studied in northern Ohio. It is parasitoid upon *Climacia areolaris* (Hagen) and, probably, upon other sisyrid neuropterons. The life history was observed under laboratory conditions. On the basis of such observations, the following are described for the first time: courtship and mating, oviposition, egg, larvae and larval activities, pupa, and emergence of the adult.

Notes are presented concerning adults in the field.

The entire life cycle occupies 9 to 15 days, the males maturing one or more days earlier than the females.

Parthenogenetic development may occur.

The host is susceptible to attack as long as it is within the cocoon, whether it is in the larval or pupal condition.

More than one larva of *Sisyridivora* may develop upon a single host.

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THE MCLACHLAN TYPES OF NORTH AMERICAN TRICHOPTERA IN THE BRITISH MUSEUM

D. E. KIMMINS[1] AND D. G. DENNING[2]

During a period of 41 years of active work with the Trichoptera, 1862–1903, Robert McLachlan described 16 North American species. Type material of 15 of these is at present in the British Museum (Natural History) and forms the basis of this study. McLachlan's descriptions and illustrations, remarkably clear and inclusive as they are, are however, largely based on such structural characters as size, color, and vestiture. The descriptions of the male and female genitalia, when given, are based on dried specimens and as such are often somewhat inadequate, and do not reach the standard of his Monographic Revision of the European Fauna. Modern species recognition is based to a large extent upon male and female genitalic characters following the clearing of the genitalia in caustic potash. The increasingly large number of described North American species, many of them obviously closely related to McLachlan's species, have created a situation where it is highly desirable that the determination of these species be made easier and more reliable.

A re-examination of the type material was made by the senior author who likewise prepared most of the descriptions and the drawings of the genitalia and wings. The original description of McLachlan's is followed by any other notes that are applicable, a description of the genitalia and designation of the holotype and allotype. The wings have been drawn by projection from specimens denuded and mounted dry, under slight pressure, as microscope preparations. All drawings of the genitalia have been made from preparations cleared in caustic potash, studied and drawn while in glycerine with the aid of a camera lucida, before being mounted in canada balsam.

Agapetus celatus McLachlan

(Figs. 1, 2)

1871. *Agapetus celatus* McLachlan, Jr. Linn. Soc. London, 11: 139, pl. 4, figs. 23, 23a, ♂, ♀.
1944. *Agapetus celatus* Ross, Bul. Illinois Nat. Hist. Surv., 23(1): 292.
1947. *Agapetus ophionis* Ross, Trans. Amer. Ent. Soc., 73: 133, fig. 11 (new synonymy).

Of the original type series, (1♂, 2♀ ♀, from California, collected by Mr. Henry Edwards) only the 2 females are now in the British Museum. There are however 1 male and 2 females, without locality labels, but labelled *Agapetus celatus* McL. in McLachlan's handwriting. The wing-venation of the male differs slightly from that figured by McLachlan, and for other reasons cannot be considered part of the type series. Below is given McLachlan's description of the general appearance of

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the insect, which is probably better and more accurate than could be made now from the female type, which has suffered somewhat from the inevitable fading.

"Blackish-fuscous. *Head* and *prothorax* clothed with golden or yellow hairs; ocelli whitish yellow; palpi and antennae blackish-fuscous. *Legs* fuscous, trochanters and tips of femora yellowish; in the ♂ the posterior tibiae are fringed with long grey hairs; in the ♀ the intermediate tibiae and first tarsal joint are strongly dilated, concave internally, and fringed with grey hairs. *Abdomen* fuscous. . . ."

"*Anterior wings* uniformly blackish, somewhat shining, with a moderately dense clothing of short brownish pubescence and long blackish fringes; veins blackish. *Posterior wings* blackish, subhyaline, and with purple reflections; fringes long and grey; veins blackish."

CALIFORNIA, (Edwards) 2♀♀, and also 2♀♀ and 1♂ (without locality, ? California) from the McLachlan collection. The two former specimens are considered to be the residue of McLachlan's cotypes, and one of them, now mounted as a microscope preparation, is the original of these new illustrations, and is hereby designated the type of *Agapetus celatus* McLachlan, 1871.

To this the following is added:

Female Genitalia, fig. 1.—Fifth sternite with a curved carina. Sixth sternite with a short, blunt, ventral process. Seventh segment with the lateral apical angles produced, the angles of the sternite less acute than those of the tergite. Eighth tergite more strongly sclerotized than sternite, apical margin with two deep, acute excisions, dividing tergite into a median lobe, apex rounded from above, the lateral lobes being bent down at right angles on each side of the median lobe, their ventral margins covered by dorsal margins of the sternite. Eighth sternite submembranous apically, basal margins produced in long slender apodemes. Within the eighth segment is a narrow, spatulate vaginal structure. Ninth segment smaller than eighth, its tergite more pigmented than sternite, and with long apodemes. Tenth segment smaller, membranous beneath, bearing a pair of two-segmented cerci. Length of fore wing of ♀, 6 mm. Wing venation as in fig. 1.

The single additional male (not of the type series) differs in venation from the female type and from the figure of the male wing given by McLachlan. Apart from these differences, the wings of this example were in such position that McLachlan's figures could not have been drawn from them. In the anterior wing, cell M_3 is shorter in relation to cell M_1; in the posterior wing, R_1 is less bent at its fusion with R_{2+3}, and there is no fork at the apex of these fused veins (this character has been shown to be variable in the other species), cells R_4 and M_1 are shorter in relation to their footstalks.

EXPLANATION OF PLATE I

FIG. 1. *Agapetus celatus* McL. female wings; a, ♀ abdominal segments 5–10, lateral aspect; b, ♀ abdominal segments 8–10, lateral aspect; c, ♀ abdominal segments 8–10, dorsal aspect; d, vaginal structure, ventral aspect. FIG. 2. *Agapetus celatus* McL. male wings; a, ♂ genitalia, lateral aspect; b, aedeagus, lateral aspect; c, genitalia, dorsal aspect; d, clasper, dorsal aspect. FIG. 3. *Tinodes consueta* McL.; a, ♂ genitalia, lateral aspect; b, genitalia, dorsal aspect; c, aedeagus and sheaths, dorsal aspect; d, genitalia, ventral aspect.

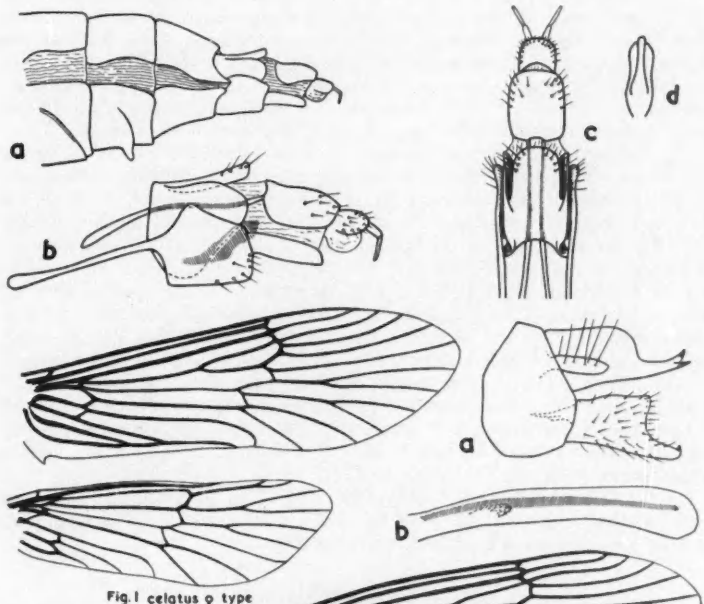

Fig. 1 celatus ♀ type

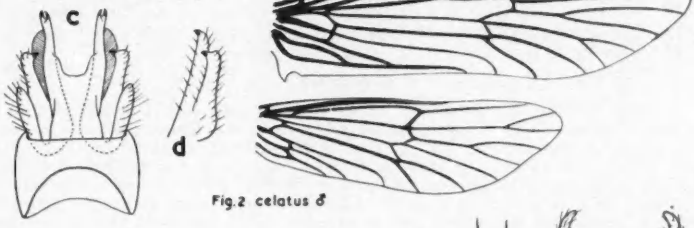

Fig. 2 celatus ♂

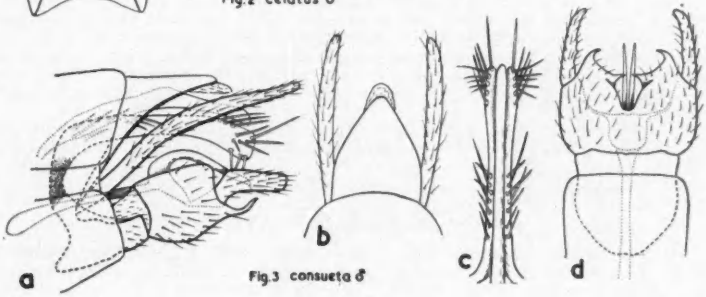

Fig. 3 consueta ♂

Male Genitalia, fig. 2.—Little could be seen of the appendages in the dried specimen. When cleared in KOH, they were seen to differ from McLachan's figure, although this is not surprising, since McLachlan wrote "these anal parts are so strongly applied one against the other in the dried example, that it is impossible to describe them with certainty." Thus these differences do not necessarily imply that this male is not conspecific with that of the type-series, now missing.

A short, blunt process present on sixth sternite; in the example before me, the process projects at right angles, but the segment basad to the process is buckled inwards, and the process should probably be directed obliquely caudad. Tenth tergite, from dorsal aspect, deeply cleft almost to base, but with membrane across basal half of excision; from lateral aspect it is deep, dorso-apical corner rounded, ventral corner produced caudad into a long projection whose apex is divided into a pair of sclerotized points, one directed caudad, the other dorsad. Cerci short, cylindrical, dorsal surface fringed Aedeagus, fig. 2b, long, cylindrical and retracted, with a spine-like duct internally and a serrate protuberance on each side near base. Claspers about as long as tenth tergite; from the side quadrate, ventro-apical angle produced as a short finger, apex upturned in a small claw; dorso-apical corner with a black-tipped tooth on mesal surface. Length of fore wing, ♂ 5, mm. Wing venation as in fig. 2.

1♂ (without locality, ? California) from the McLachlan collection, and labelled in his handwriting *Agapetus celatus* McL. This specimen is now mounted as a microscope preparation.

Tinodes consueta McLachlan

(Figs. 3, 5)

1871. *Tinodes consueta* McLachlan, Jr. Linn. Soc. London, 11: 138, pl. 4, fig. 22.
1944. *Tinodes consueta* Ross, Bul. Illinois Nat. Hist. Surv. 23(1): 293.

McLachan's description is as follows:

"Blackish-fuscous. *Head* and *thorax* clothed with pale golden hairs; eyes greyish yellow in their upper portion, blackish in the lower; antennae fuscous, somewhat ochreous, more or less annulated with paler; palpi fuscous. *Legs* pale yellow; the coxae, the anterior femora beneath, and sometimes the other femora (also beneath) fuscous. Abdomen fuscous, more or less testaceous or ochreous (colour probably altered), appendices pale; app. sup. long, scarcely curved, hairy, and linear; app. inf. two-jointed, the basal joint forming a broad base, excised above, and the lower angle produced into a short curved spine, the second joint forming a curved finger-shaped appendage arising from the excision of the basal joint; above there is a very large, broadly triangular median lobe placed between the app. sup., the middle with a distinct elevated carina, the sides sloping downward."

"*Anterior wings* long, gradually widening from the base; the apex elliptical, dingy yellow, with dense golden-yellow pubescence, the naked circular space

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EXPLANATION OF PLATE II

FIG. 4. *Tinodes consueta* McL. male wings. FIG. 5. *Smicridea fasciatella* McL. male wings; a, ♂ genitalia, lateral aspect; b, genitalia, dorsal aspect; c, aedeagus, ventral aspect. FIG. 6. *Smicridea fasciatella* McL.; a, ♀ genitalia, lateral aspect; b, ninth and tenth segments, dorsal aspect; c, eighth and ninth segments, ventral aspect.

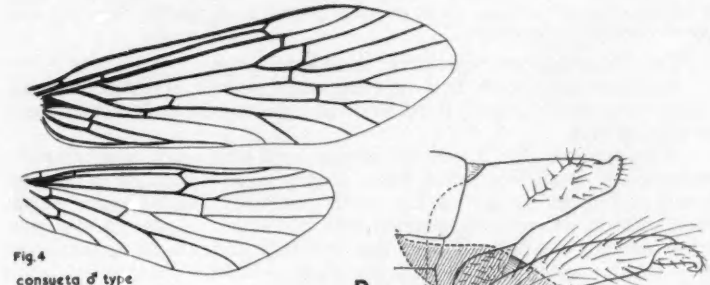

Fig. 4
consueta ♂ type

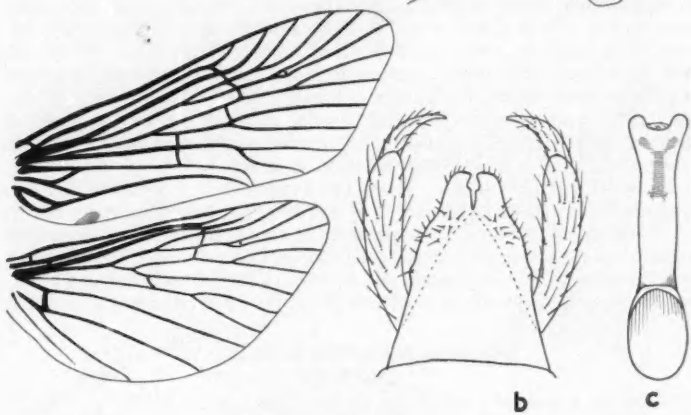

Fig. 5 fasciatella ♂ type

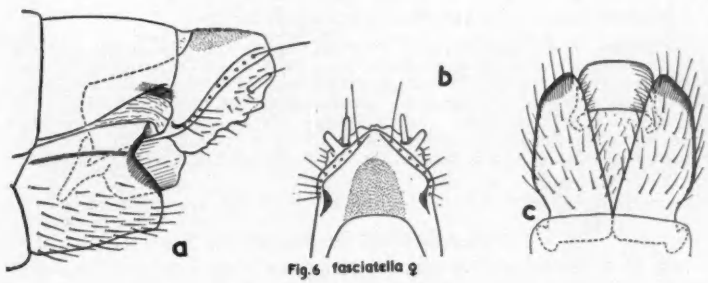

Fig. 6 fasciatella ♀

near the base scarcely evident; fringes golden grey; neuration arranged as usual in *Tinodes*, greyish fuscous. *Posterior wings* greyish smoky, subhyaline, and with green reflections; fringes grey."

The following new description is added:

Maxillary palpi with first segment short, second and fourth equal, half as long again as first, third twice as long as second, fifth five times as long as first.

Male genitalia, fig. 3.—Ninth tergite hood-like, apico-mesal portion triangularly produced, lower basal angles extend ventrad as narrow bands and meet margin of the ninth sternite. Tenth tergite small, membranous. Cerci long, slender, with fine setae. Aedeagus elongate, lying between two curved, blade-like sheaths with truncate apices; bases of sheaths curved caudad and attached to dorsal margins of ninth sternite, and near attachment they are darkly pigmented; dorsal surface of sheaths and their apices bear a number of stout, socketed spines. Ninth sternite extends slightly beyond the eighth, quadrate. Claspers two-segmented, basal segment large, fused at their bases ventrally; ventro-apical corner divided into two acute claws curved mesad, fig. 3d; from dorsal surface of the fused basal segments arises a pair of spines, lying close together and with a common base, extending basad as a thin, elongate process; from lateral aspect spines curved caudad, each with a small tooth and a bristle ventrally about midway; apical segment of clasper slender, laterally compressed, curved slightly at base. Length of fore wing, ♂, 7 mm. Wing venation as in fig. 4.

CALIFORNIA, (Edwards). From the type-series of 4 males, the one designated as type had one pair of wings missing, probably removed by McLachlan for figuring. This specimen is now mounted as a microscope preparation. Subsequent to the publication of his description, McLachlan acquired an additional male and female. The latter is not dealt with here, as there is no evidence that it is correctly associated with the male.

Smicridea fasciatella McLachlan

(Figs 5, 6)

1871. *Smicridea fasciatella* McLachlan, Jr. Linn. Soc. London, 11: 136, pl. 4, fig. 19.
1944. *Smicridea fasciatella* Ross, Bul. Illinois Nat. Hist. Surv. 23(1): 85, figs. 330, 340.
1947. *Smicridea fasciatella* Ross, Trans. Amer. Ent. Soc. 73: 144.

McLachlan describes the species as follows:

"Fuscous. *Head* clothed with cinereous hairs, the two large posterior tubercles emiting brownish-black hairs: eyes deep black: antennae fuscescent, each joint above with a whitish spot, distinct only towards the base of the thread: palpi obscure yellowish or fuscescent. *Mesonotum* fuscous, with a tuft of brownish-black hairs on each shoulder. *Legs* yellowish; the intermediate and posterior tibiae, especially the latter, clothed with blackish or brownish hairs, principally on the outer side. *Abdomen* fuscous: in the ♂ the app. sup. seem to form two

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EXPLANATION OF PLATE III

FIG. 7. *Macronemum polygrammatum* McL. male wings; a, ♂ genitalia, lateral aspect; b, genitalia, dorsal aspect (terminal fringe omitted). FIG. 8. *Apatania frigida* McL. male wings; a, ♂ genitalia, lateral aspect; b, genitalia, dorsal aspect; c, genitalia, ventral aspect.

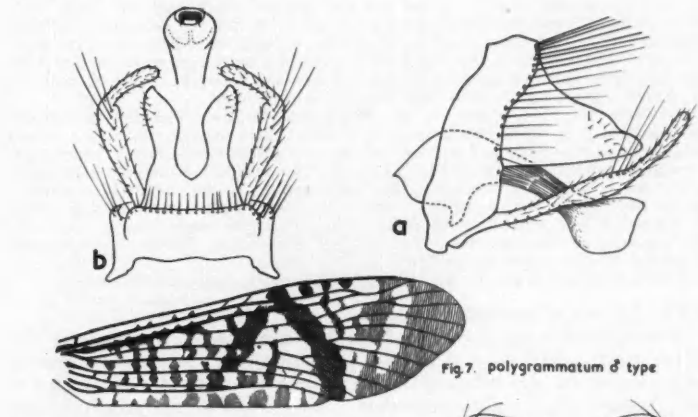

Fig.7. polygrammatum ♂ type

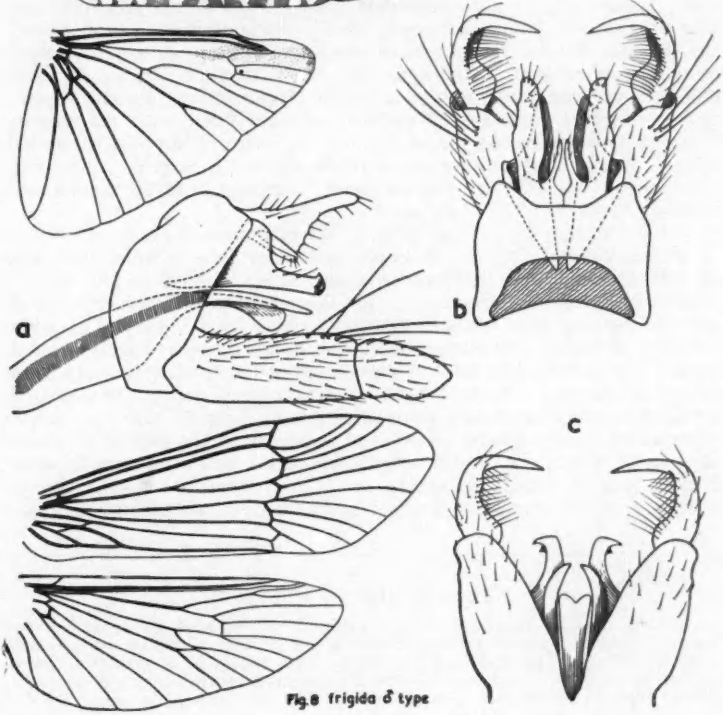

Fig.8 frigida ♂ type

long straight blades closely applied one against the other; app. inf. long, two-jointed, directed upwards, clothed with fuscous hairs, the second joint short and acute, curved strongly downward; penis slender, cylindrical, obtuse, semi-pellucid: in the ♀ the extremity of the abdomen is furnished with a short triangular lobe projecting from the last dorsal segment and directed somewhat upward; on each side, below this, is a broadly obtuse lobe, little prominent."

"*Anterior wings* smoky fuscous, almost blackish, with short golden pubescence; near the base is a white clouding, little distinct, and scarcely forming a broad fascia; beyond the middle a narrow, white, straight fascia, almost interrupted by the dark veins; and before the apex a similar fascia, which is slightly incurvated on the costal and inner margins; the veins are dark; the subcosta extending slightly beyond the middle of the costa; the median cellule commencing before the discoidal, and extending to its middle. *Posterior wings* smoky blackish, with concolorous fringes; the costal margin irregularly sinuate; the subcosta joining the margin before the middle."

"Five examples taken by Mr. Belfrage in Texas in July and October."

The following description is added:

Male Genitalia, fig. 5.—Short lateral filaments arise from base of the fifth sternite. Abdomen with two pairs of ovate, reticulate, internal sacs, opening on the intersegmental membranes laterally between the sixth, seventh and eighth segments. Ninth and tenth tergites fused into an elongate triangular hood, apex upturned; from dorsal aspect, fig. 4b, apex divided into a pair of small, quadrate processes, separated by a narrow excision. Aedeagus, fig. 4a, of medium length, its basal half bent ventrad; apex, viewed laterally, truncate; from ventral aspect, fig. 4c, slightly clavate and excised, excision filled with membrane. Claspers two-segmented, basal segment cylindrical, slightly expanded toward apex, about as long as the ninth and tenth tergites; apical segment less than half as long as basal, narrower, curved mesad and ventrad, tapering to an acute apex.

Length of fore wing, ♂, 5½ mm. Wing venation as in fig. 4.

Female Genitalia, fig. 6.—Abdomen with short lateral filaments at base of fifth sternite, no reticulated internal sacs. Eighth tergite with a tuft of hairs partly concealed under the apical-lateral corners; eighth sternite, fig. 5c, from beneath divided to base by a V-shaped excision, forming two lobes, quadrate in side view, apical margin broadly excised, darkly pigmented and with a pigmented rib extending basally from center of excision. Ninth tergite hood-like, apical margin triangularly produced, fringed with long setae arising from beneath a carina; clasper receptacles small, shallow, situated at basal end of the carina; on dorsal surface of tergite fig. 5b, is a thimble-shaped patch of minute setae. Ninth sternite small, appearing as a thin, quadrate plate between apices of eighth sternite. Tenth tergite from the side, forming a pair

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EXPLANATION OF PLATE IV

FIG. 9. *Apatania frigida* McL.; a, ♀ genitalia, ninth and tenth segment, dorsal aspect; b, eighth to tenth segments, ventral aspect; c, vaginal structure, ventral aspect. FIG. 10. *Limnephilus miser* (McL.) male wings; a, ♂ genitalia, lateral aspect; b, genitalia, ventro-caudal aspect; c, genitalia, dorsal aspect; d, aedeagus, dorsal aspect; e, aedeagus, lateral aspect. FIG. 11. *Limnephilus miser* (McL.); a, ♀ genitalia, eighth to tenth segments, lateral aspect; b, ninth and tenth segments, dorsal aspect; c, eighth to tenth segments, ventral aspect; d, vaginal structure, ventral aspect.

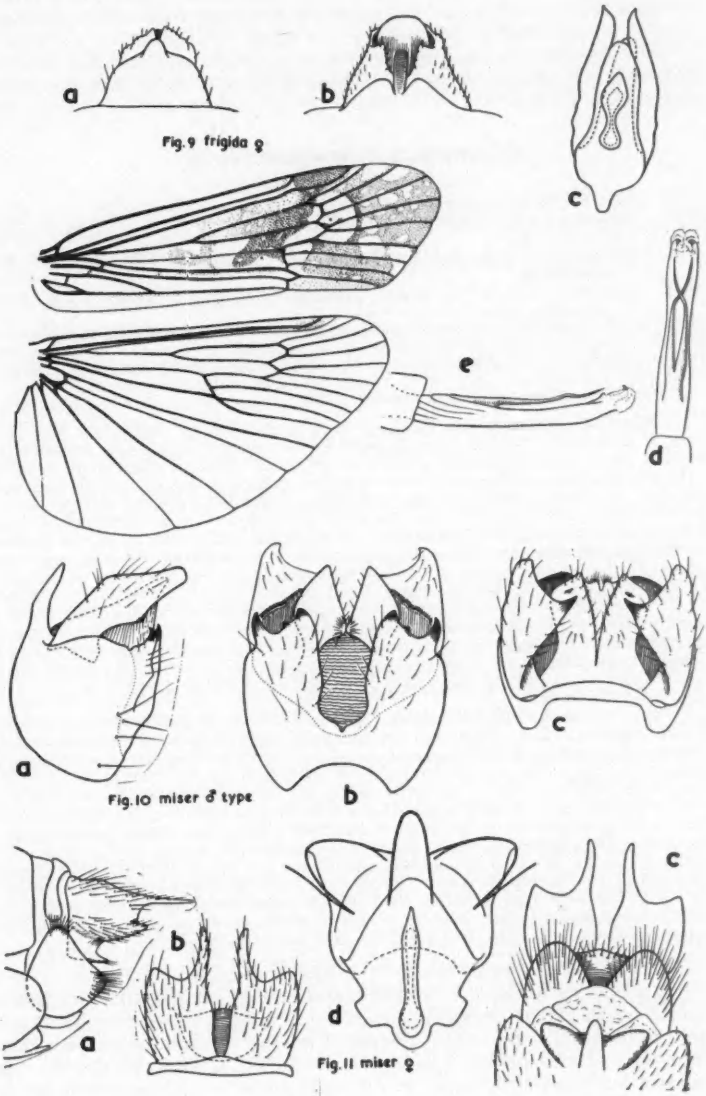

Fig. 9 frigida ♀

Fig. 10 miser ♂ type

Fig. 11 miser ♀

of narrow plates attached to the ninth, margins irregular; each plate carries a blunt process and a slender, single-segmented cercus, terminating in a short bristle. Length of fore wing, ♀ 5½ mm.

Two specimens mounted as microscope preparations are hereby designated as male holotype and female allotype of *Smicridea fasciatella* McLachlan, 1871.

Macronemum transversum (Walker)

(Fig. 7)

1852. *Hydropsyche transversa* Walker, Cat. Neur. Brit. Mus., 1: 114.
1871. *Macronema polygrammatum* McLachlan, Jr. Linn. Soc. London, 11: 129, pl. 3, fig. 14.
1934. *Macronema polygrammaticum* Betten, New York State Mus. Bul., 292: 204 (misspelling).
1936. *Macronema transversum* Milne, Studies N. A. Trich., 3: 72, 74 (*M. polygrammatum* listed as synonym).
1940. *Macronema transversum* Betten and Mosely, The Francis Walker types of Trichoptera in the British Museum, 1940: 26, fig. 11.
1944. *Macronemum transversum* Ross, Bul. Illinois Nat. Hist. Survey, 23(1): 117.

McLachlan's description is as follows:

"Fuscous. *Head:* occiput with two very large, oval (or somewhat reniform) yellow tubercles on the disk, on each side, and two more elongate ones posteriorly, each of these latter extending below the eye, these tubercles clothed with short yellow hairs; face and palpi yellow, or yellow ochreous; antennae very long and slender, the basal joint ochreous, somewhat fuscescent, the succeeding ten or twelve joints yellow, each with a very narrow fuscous ring at its apex, the rest fuscous, gradually shading off from the yellow of the basal joints. Thorax fuscous, hairless; the metanotum with a depressed space in the middle, which is somewhat yellowish. *Legs* pale yellow, a black dot on each of the trochanters, and the apex of the tibiae, and the apical joint of the tarsi also with a black point; anterior tibiae with two short and subequal apical spurs; intermediate and posterior tibiae each with two pairs of long and unequal yellow spurs. *Abdomen* ochreous, somewhat fuscescent, margin of the terminal joint with a fringe of long yellow hairs; inferior appendices very long and slender, yellow and cylindrical, approximate at the apex, two-jointed, the apical joint curved upwards; penis short, roundly capitate at its apex."

"*Anterior wings* long and narrow, gradually dilated to before the apex, which is subelliptical, nearly nude, and shining, pale straw-yellow with numerous pale fuscous markings, as follows: rather beyond the middle are two fasciae commencing together on the costa, but then running obliquely into the inner margin in different directions, leaving a broad triangular space between them, in which is a line and one or two points; the apex broadly fuscous, ending in a narrow transverse curved line of the pale ground-colour; the basal portion of the wing before the first fascia is occupied by numerous short transverse streaks and points, and then several similar streaks between the second fascia and the apical portion; pterostigma indicated by a subopaque space clothed with short yellow pubescence; veins pale yellow. *Posterior wings* whitish hyaline, the costa abruptly excised before the apex; extreme apex rather broadly margined with pale grey; veins greyish-white, more obscure at the apex; fringes of the anal margin whitish."

A new description of the male genitalia is added:

Male Genitalia, fig. 7.—Ninth tergite heavily fringed with long setae. Tenth tergite, from the side, triangular, forming a hood over the aedeagus; from dorsal aspect, fig. 7b, excised almost to base, sides of the excision sinuous, so that the opening is constricted about midway; the two branches of the tergite taper to subacute apices. Aedeagus stout at its base, stem slender, apex clavate, more so in side view than from above; within the apex, in dorsal aspect, fig. 7b, can be seen a pair of claws,

directed dorsad. Claspers long, slender, two-segmented, but joint on outer surface obscure; apical segment directed mesad, slightly clavate. Length of fore wing ♂ 13.5 mm. Wing venation as in fig. 7.

UNITED STATES. A male, with one pair of wings and the abdomen removed and mounted as microscope preparations, is hereby selected as type of *Macronemum polygrammatum* (McLachlan), 1871.

Radema stigmatella (Zetterstedt)

(Figs. 8, 9)

1867. *Apatania frigida* McLachlan, Stettiner Ent. Zeitg., 28: 57.
1876. *Apatania frigida* McLachlan, Rev. and Syn. Trich. pt. 4: 213, pl. 23 (syn. of *stigmatella*)
1944. *Radema stigmatella* Ross, Bul. Illinois Nat. Hist. Surv., 23(1): 297.

McLachlan's description is as follows:

"Black. Antennae fuscescent. Head and thorax with greyish hairs. Anterior wings griseous, sparsely clothed with yellowish-griseous hairs; venation somewhat obscure; posterior wings a little paler. Legs testaceous; femora blackish fuscous."

"♂. Superior appendages either absent or minute; intermediate appendages triangularly elongate, acute, fusco-testaceous; inferior appendages two-jointed, basal joint elongate, cylindrical, hairy, brownish, second testaceous, claw-like, strongly incurved, acute; upper sheaths cylindrical, towards the apices abruptly incurved; lower sheaths shorter, slender, incurved, forcipate."

To this is added the following:

Male Genitalia, fig. 8.—Surface of the fifth sternite with a fine honeycomb reticulation, in the basal half on each side there is a small circular pit with a pore at its base. Ninth segment short, apical margin from above broadly excised, base of the excision flattened. Cerci bifurcate, upper branch long, sparsely clothed with short setae, apex rounded; viewed from lateral aspect, ventral margin dilated ventrad as a triangular expansion; lower branch short, slender and finger-like. Tenth segment forming a pair of elongate plates, seen from lateral aspect dorsal portion broadly rounded at base; apical half narrow, parallel-sided, apex outturned as small, acute teeth. Aedeagus long, slender, apex triangularly excised, base encircled by a sleeve, internally arises a pair of long spine-like sheaths. Clasper stout, two-segmented; basal segment about twice as long as apical segment, apex from above or beneath curved mesad as a long acute claw, fig. 8b, c. Length of fore wing, ♂, 7¼ mm. Wing venation as in fig. 8.

Female Genitalia, fig. 9.—Texture of the fifth sternite as in the male. Mesal portion of eighth sternite produced caudad as a trilobed subgenital plate; outer lobes rounded, transparent, central lobe long, finger-like, somewhat upcurved. Ninth tergite hood-like, mesal portion produced caudad as a sub-triangular projection; lateral margins of tergite produced ventrad, almost meeting beneath basally, forming a deep U-shaped excision, beyond which is seen the rounded plate-like sternite. Tenth tergite small, with a V-shaped notch in center of apical margin. Internal structure as in fig. 9c. Length of fore wing, ♀, 9 mm.

McLachlan's specimens were from Norwegian Lapland, Alten and from Slave Lake, North America. One of the males from Alten has been selected as holotype and mounted as a microscope preparation. A female, from the same locality, with the abdomen removed and

mounted as a microscope preparation by K. J. Morton, is designated allotype. The male referred to by McLachlan from Slave Lake is undoubtedly conspecific.

Limnephilus miser (McLachlan)

(Figs. 10, 11)

1875. *Limnophilus miser* McLachlan, Rev. and Syn. Trich. pt. 2: 89, pl. 9, figs. 1–5.
1880. *Limnophilus miser* McLachlan, Rev. and Syn. Trich. pt. 9: VII, XXIII.
1944. *Limnephilus miser* Ross, Bul. Illinois Nat. Hist. Surv. 23(1): 298.

McLachlan describes *miser* as follows:

"Deep black; pronotum and wing-shoulders with long and strong silvery hairs, mixed with black; posterior warts on the head not prominent, with black hairs; face sparsely clothed with silvery hairs, the facial eye-margins narrowly silvery. Antennae fuscous, annulated with testaceous; basal joint stout for the size of the insect. Palpi dusky-testaceous. Legs testaceous, the femora usually fuscescent excepting at the apex; spines few and black. Abdomen with a reddish line on each side. Anterior wings rather narrow, gradually dilated to the apex which is very obliquely truncate; ground colour smoky-fuscous (lighter or darker according to the individual); costal margin to the radius, and as far as the pterostigma, whitish hyaline; fenestrate spot broad and distinct, whitish-hyaline, as is also the anastomosal space which is very large, traversed by fuscous veins, and the anastomosis also fuscous; in addition to these markings there are more or less numerous whitish-hyaline dots spread over the dark portions of the wing; pterostigma darker than the ground: neuration (excepting the subcosta) fuscous; discoidal cell long and narrow; 4th apical cell sub-acute at the base; hairs of veins long and black; pubescence of membrane blackish in the dark portions, silvery in the pale markings. Posterior wings whitish-hyaline; neuration scarcely darker; pterostigma slightly dusky; fringes rather long, greyish; discoidal cell shorter; 3rd apical cell longer than the 1st, 4th sub-acute at the base; upper branch of cubitus furcating about opposite to the middle of the discoidal cell."

To this the following description is added:

In the male, the anterior femur bears a short row of spines on the basal half of its lower surface. ***Male Genitalia***, fig. 10.—Ninth abdominal segment reduced dorsally to a narrow band, lateral portion large, triangular. Cerci large, the inner angle forming an acute black spine; ventral surface with a blackened ridge which extends obliquely from this spur to the outer margin; from lateral aspect cercus elongate, broadest midway, apex truncate. Plates of the tenth tergite subtriangular from the side, divergent from dorsal aspect, fig. 10c; outer margins sinuous and bearing a small, dorsally directed tooth on dorsal surface near apex; ventro-apical angles rounded, hairy. Aedeagus, fig. 10e, long, slender, apex with a pair of small, upcurved hooks embedded in membrane; lateral arms acuminate, sinuous, crossing each other before the apex, fig. 10d. Claspers fused to ninth segment; from caudal view short,

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EXPLANATION OF PLATE V

FIG. 12. *Limnephilus moselyi* new species, male wings; a, ♂ genitalia, lateral aspect; b, genitalia, ventro-caudal aspect; c, genitalia, dorsal aspect; d, aedeagus, dorsal aspect; e, aedeagus, lateral aspect. FIG. 13. *Limnephilus moselyi* new species; a, ♀ genitalia, ninth and tenth segments, lateral aspect; b, dorsal aspect; c, eighth to tenth segments, ventral aspect. FIG. 14. *Stenophylax limbatus* McL.; a, ♂ genitalia, lateral aspect; b, genitalia, dorsal aspect; c, aedeagus, dorsal aspect; d, genitalia, ventro-caudal aspect.

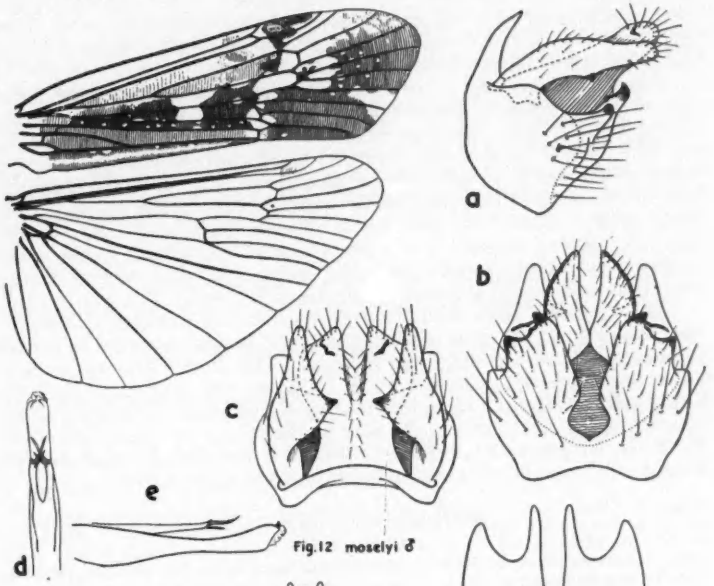


Fig.12 moselyi ♂

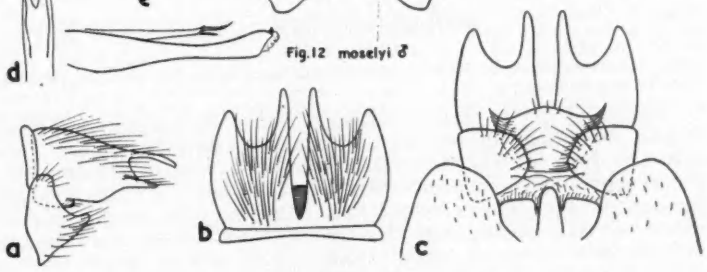


Fig.13 moselyi ♀

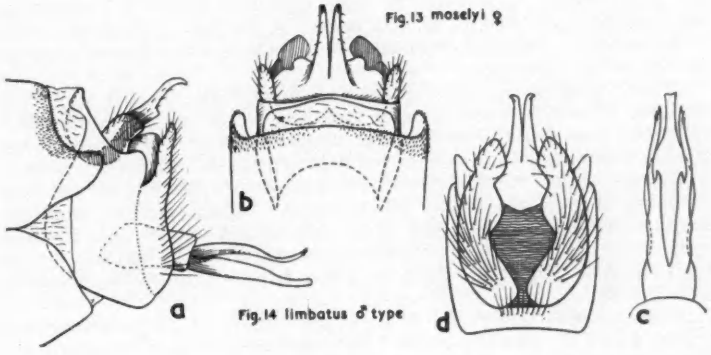


Fig.14 limbatus ♂ type

outer apical angle produced as a distinct tooth, inner angle forming a blunt tooth, a smaller triangular tooth located midway between them, fig. 10b; teeth blackened and from side view upturned. Length of fore wing, 8.5 mm. Wing venation as in fig. 10.

Female Genitalia, fig. 11.—Vulvar scale of eighth sternite with mesal lobe slender, subacute, longer than the outer lobes, which are ovate and divergent, fig. 11c. Internal structure shown diagrammatically in fig. 11d. Ninth tergite very narrow; ninth sternite forming a pair of hairy plates joined ventrally by a membrane; from lateral aspect, fig. 11a, plate is subtriangular, upper angle subacute, the lower obtuse; from ventral aspect, fig. 11c, apical margin elliptical. Tenth tergite, fig. 11b, tubular, consisting of a pair of broad, horizontal plates, mesal angles considerably longer than the outer, digitate; ventral margin slightly produced and rounded. Length of fore wing, ♀, 9 mm.

The type is a male from Haparanda, Gulf of Bothnia. It was in bad condition at the time of description and is now mounted in canada balsam; one anterior wing was missing. The female allotype is from Alten in Finmark, collected by F. Walker; the abdomen has been cleared in KOH and mounted in canada balsam. The species was recorded from Greenland by Mosely in 1929 from a collection made by R. W. G. Hingston at Kugssuk, Godthaab Fjard, in July, 1928, but the record was based on an error in determination.

Limnephilus moselyi n. sp.

(Figs. 12, 13)

1929. *Limnophilus miser* Mosely, Ann. Mag. Nat. Hist. (10) 4: 504 (Greenland examples).

Head and thorax piceous, sparsely clothed with silvery and black hairs. Antennae reddish-brown, with testaceous annulations. Palpi fuscous. Legs fuscous, with few black spines; anterior femur with a row of short spinules on ventral surface in basal half. Abdomen reddish fuscous, with a reddish lateral line. Anterior wing smoky fuscous, costal and subcostal areas whitish hyaline; fenestrate spot and the area around the anastomosis whitich-hyaline, small whitish dots in parts of the darker areas. Discoidal cell long, generally definitely longer than its footstalk; 4th apical cell narrowed at its base. Posterior wing whitish-hyaline, faintly brownish at pterostigma; 4th apical cell narrow at base but not subacute.

Male Genitalia, fig. 12.—Similar to *L. miser* McL., but the cerci more elongate, in side view less expanded midway, dorsal margin more evenly rounded; from dorsal view, fig. 12c, apical angle of cercus is narrower and the inner angle further removed basally from it. Plates of the tenth tergite are larger; in side view the apices are broader and extend considerably beyond the apices of the cerci. Lateral arms of aedeagus short, obliquely truncate, armed at their apices with a pair of stout spines, fig. 12d. Claspers with the inner apical tooth definitely longer than the outer, fig. 12e. Length of fore wing 9 mm. Wing venation as in fig. 12.

Female Genitalia, fig. 13.—Differs from *miser* McL. in the form of the vulvar scale, fig. 13c, the mesal lobe is stouter and more truncate, the outer lobes have straight (not rounded) apical margins. Ninth sternite

from lateral view fig. 13a, with dorsal margin definitely concave, from beneath fig. 13c, apical margin truncate. Dorsal plates of tenth segment with outer angle produced almost as far as the inner, so that they enclose an elliptical excision (in *miser* this excision is rectangular). Length of fore wing 8–9 mm.

Holotype.—Male.—Mounted as a microscope preparation. W. Greenland: Godthaab Fjord, Kugssuk, 30 ft., 16–28. VII, 1928, (R. W. G. Hingston), (Oxford University Expedition). *Allotype*, Female.—Mounted as a microscope preparation. Same data as for male. Types deposited in British Museum (Natural History); paratypes in B. M. (N. H.) and Hope Dept. Museum, Oxford, same data as for male.

Grammotaulius sibericus McLachlan

Grammotaulius sibericus was recorded in error from Greenland.

Pycnopsyche limbata (McLachlan)

(Figs 14, 15)

1871. *Stenophylax limbatus* McLachlan, Jr. Linn. Soc. London, 11: 108, pl. 2, fig. 2.
1934. *Stenophylax limbatus* Betten, New York State Mus. Bul., 292: 344, pl. 48, figs. 5, 6.
1944. *Pycnopsyche limbata* Ross, Bul. Illinois Nat. Hist. Surv., 23(1): 299.

McLachlan describes *limbata* as follows:

"*Head* and *thorax* reddish testaceous, with sparse reddish hairs; antennae testaceous, with fuscous rings; palpi yellowish; eyes black. *Legs* yellow, tibiae and tarsi with short black spines, a black point on each trochanter internally. *Abdomen* fuscous above, ochraous beneath; margin of last dorsal segment regularly concave in front, produced at the sides into a triangular tooth, the upper edge of which is excised and beset with numerous very short black spiny hairs; app. sup. small, yellow, subquadrate, truncate, fringed with yellow hairs; app. intermed. long, in the form of two closely applied straight spines, the tips of which are suddenly curved downwards; app. inf. directed upwards, projecting beyond the lateral production of the segment, yellow, truncate at the apex, and fringed externally with long yellow hairs.

"*Anterior wings* short and broad, much dilated at the apex; the apical margin oblique, pale testaceous, the membrane finely rugulose, nearly nude, and shining; a cloud in the cellula thyridii extending also above it, and there enclosing a white dot at the thyridium; two irregular spots, one placed at the base of the second, the other in a similar position in the fourth, apical cells, and a broad apical margin which is dentate internally (being produced into an acute triangle along each apical cell) pale brown; ramus clavalis margined beneath with brown; veins testaceous, with short concolorous hairs; first apical cell longer than the second, but not inordinately so. *Posterior wings* hyaline, whitish, slightly yellowish at the apex; veins pale yellowish; fifth apical cell scarcely reaching the anastomosis."

To this is added a new description of the genitalia:

Male Genitalia—fig. 14.—Eighth tergite with apical margin incised as a broad shallow excavation, lateral corners with apices rounded, dorsal margins somewhat concave, entire margin bearing short spines. Dorsally, fig. 14b, ninth segment reduced to a narrow transverse band; lateral portion inconspicuous, rounded. Tenth tergite moderately long, slender and claw-like, extreme apex turned ventrad, a blunt angulation about midway along ventral margin; tenth tergite at base is impressed to form a pair of concave depressions below margin of ninth segment. Cerci short, spinose, from the side broad and truncate, from above narrow and acute. Aedeagus, fig. 14c, of moderate length,

tapering to a short, slender, slightly-excised apex; lateral arms almost reaching apex of aedeagus, spiniform, from above sinuous, a short tooth on mesal margin about midway, apices with two or three small, acute teeth. Claspers short, fused to ninth segment, upper apical angle flattened, directed dorsad; from caudal view, fig. 14d, curved mesad, inner margins sinuous, apices forming blunt, lanceolate plates. Length of anterior wing, ♂, 13 mm. Wing venation as in fig. 15.

NEWFOUNDLAND: St. John's (G. F. Mathew). Holotype ♂, mounted as microscope preparations, paratype ♂ pinned. Both examples were in rather poor condition and each lacked an anterior wing; in addition the abdomen of the paratype has been devoured by insect pests.

Pycnopsyche gentilis (McLachlan)

(Fig. 16)

1871. *Stenophylax gentilis* McLachlan, Jr. Linn. Soc. London, 11: 108
1916. *Eustenace gentilis* Banks, Can. Ent., 48: 122.
1934. *Stenophylax gentilis* Betten, New York State Mus. Bul., 292: 342, pl. 48, figs. 3, 4.
1944. *Pycnopsyche gentilis* Ross, Bul. Illinois Nat. Hist. Surv., 23(1): 299.

McLachlan's description is as follows:

"The whole body, including antennae, palpi and legs, testaceous; tibiae and tarsi with black spines; eyes black. The last dorsal segment of the abdomen is conically produced at its apex, which is black and scabrous; app. sup. small, rounded, concave internally, yellow, and fringed with yellow hairs; app. intermed, black, truncate (?); app. inf. directed upwards, yellow, fringed externally with long yellow hairs, the apex black and truncate, furnished with small teeth.

"*Anterior wings* elongate, broad, the apex parabolic, nearly uniformly pale yellow, almost nude, and shining, the membrane finely rugulose; inner margin (area suturalis) deeper yellow; apical margin narrowly obscure; veins yellow, the anastomosis fuscescent; a whitish dot at the thyridium, and another at the arculus. *Posterior wings* hyaline, tinged with yellow; anterior margin deeper yellow."

To this the following is added:

Male Genitalia—fig. 16.—Eighth tergite of male with a quadrate area of dense black spinules along apical margin, turned ventrad over the narrow dorsal margin of the ninth segment. Cerci short, divergent, fig. 16b, concave and shell-like, apical margin fringed with hairs; mesal margins appear to be fused to the tenth segment; apical margin of tenth tergite produced caudad as a pair of short, closely-appressed processes. Aedeagus slender, slightly upcurved and tapering, apex excised from above, fig. 16c; lateral arms short, stout and brownish, apices bearing a tuft of stout, spiniform setae. Claspers fused to ninth segment, upper angles from the lateral aspect produced dorsad as dilated, cup-shaped apices, margins serrate and black. Length of fore wing, ♂, 17 mm. Wing venation as in fig. 16.

EXPLANATION OF PLATE VI

FIG. 15. *Stenophylax limbatus* McL. male wings. FIG. 16. *Stenophylax gentilis* McL. male wings; a, ♂ genitalia, lateral aspect; b, genitalia, dorsal aspect; c, aedeagus, dorsal aspect; d, genitalia, ventro-caudal aspect. FIG. 17. *Neophylax concinnus* McL. male wings; a, ventral processes of sixth to eighth abdominal segments, ventral and lateral aspect.

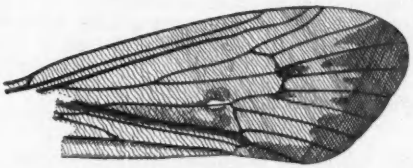
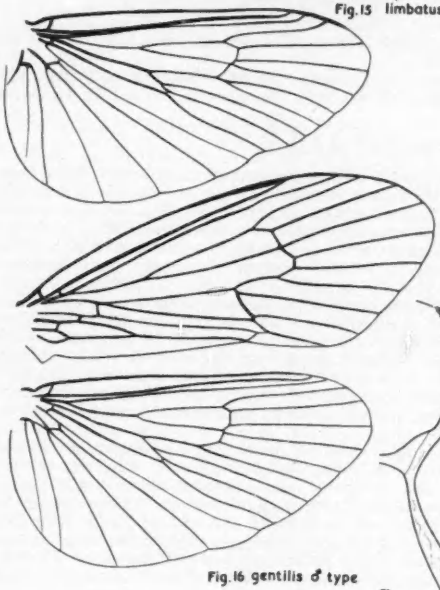
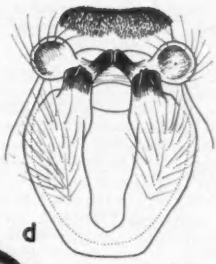


Fig.15 limbatus ♂





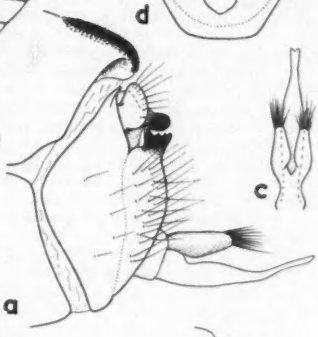


Fig.16 gentilis ♂ type

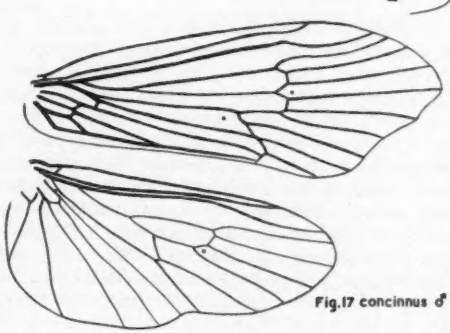


Fig.17 concinnus ♂ type

NEW HAMPSHIRE: White Mountains (H. Edwards) 1 ♂. Type with the abdomen and one pair of wings mounted as microscope preparations.

Neophylax concinnus McLachlan

(Figs. 17, 18)

1871. *Neophylax concinnus* McLachlan, Jr. Linn. Soc. London, 11: 111, pl. 2, figs. 3–3a.
1907. *Neophylax concinnus* Ulmer, Genera Insectorum, 60: pl. 8, figs. 69, 70.
1909. *Neophylax autumnus* Vorhies, Trans. Wisc. Acad. Sci. 16: 669, pl. 55, figs. 9–14 (new synonymy).
1934. *Neophylax autumnus* Betten, N. Y. State Mus. Bul., 292: 373, pl. 55, figs. 1–3.
1944. *Neophylax autumnus* Ross, Illinois. Nat. Hist. Surv., 23(1): 203, fig. 697A, 700, 702.

McLachlan describes *concinnus* as follows:

"*Head* (with the antennae, palpi) and *thorax* testaceous; occiput, basal joint of antennae, and prothorax clothed with testaceous, with an admixture of fuscous hairs; and there is a fringe of similar hairs on the facial margin of the eye-sockets; eyes dark coppery. Legs testaceous, the posterior tibiae paler, tibiae and tarsi with few, short, black spines; spurs reddish-testaceous. *Abdomen* pale whitish testaceous; on the antepenultimate ventral segment is a very small, reddish-testaceous, triangular tooth, and on the penultimate segment a much larger tooth; appendices testaceous; app. sup. small, rounded, and ear-shaped, extending little beyond the cavity of the last segment; app. intermed. placed close together, proceeding from under the middle of the upper margin of the segment, nearly straight, and flattened laterally; when viewed from the side each appendage is seen to be dilated at the base, then with the upper margin excised to the apex, which is obtuse; app. inf. inserted close together on the ventral margin, band-like, curved strongly inwards, forming a deep incision when viewed from beneath, the apex obtuse.

"*Anterior wings* fulvous, thickly clothed with short, procumbent, fuscous pubescence, the apical half irrorated with many small and indistinct whitish dots; inner margin with three yellow spots, viz., an elongate one at the base, a long triangular one about the middle, and a small one before the anal angle; the pubescence in the spaces between these spots is darker, almost blackish fuscous; apical fringe alternately fuscous and whitish; veins testaceous, the costal margin at the base, and the basal portion of the radius, ciliated with fuscous. *Posterior wings* subhyaline, slightly smoky; the fringes at the anal angle very long, silky and whitish."

A new description of the male genitalia is added:

Male Genitalia—fig. 18.—Sixth sternite bears a short acute process, seventh sternite a much longer one, and the eighth sternite a minute projection, fig. 17a. Ninth segment reduced to a narrow band dorsally, lower half quadrate from lateral view, bearing a recurved hooked process arising from the dorsal margin, mesal surface of process extending as a triangular flange, directed caudad and mesad. Tenth tergite quadrifid, the two upper branches almost contiguous, fig. 18c, plate-like, broad at their bases, dorsal margin sinuate; the lower branches contiguous, somewhat longer than the upper, digitate from the side. Aedeagus simple, tubular, with a slender central duct. Claspers short, one-segmented; from the side obliquely truncate, ventral margin concave; viewed ventrally, fig. 18d, inner margins produced as fingers directed mesad and slightly curved caudad at apex; inner basal angles small, rounded, approximate, separated from the finger-like branches by a deep rounded incision. Ventral margin of the ninth sternite

truncate, mesal portion slightly produced and excised. Length of fore wing, 9 mm. Wing venation as in fig. 17.

NEW YORK: West Farms (J. Angus), 1 ♂ from the McLachlan Collection.

The type has now been cleared in KOH and mounted as a microscope preparation, one pair of wings mounted dry.

Heteroplectron californicum McLachlan

(Figs. 19, 20)

1871. *Heteroplecton californicum* McLachlan, Jr. Linn. Soc. London, 11: 125, pl. 3, fig. 10.
1907. *Heteroplectron californicum* Ulmer, Genera Insectorum, 60: pl. 16, fig. 146.
1944. *Heteroplectron californicum* Ross, Bul. Illinois Nat. Hist. Surv. 23(1): 301.

McLachlan's description is as follows:

"Blackish fuscous. *Head* clothed with golden hairs, springing from tubercles on the crown; thus there is a rounded tubercle on each side close to the eyes, another in front between the basal joints of the antennae (these simulate ocelli), and an elongate one on each side on the posterior margin (when the hairs are removed, these tubercules seem to be paler brown than the ground-color): antennae fuscous or black, somewhat yellowish in some ♂ individuals, with obsolete darker annulations; eyes dark coppery; palpi clothed with fuscous hairs. *Prothorax* clothed with golden hairs; and there is a broad line of similarly coloured hairs down the middle of the *mesothorax*. Legs testaceous, darker in the ♀; in the ♂ the outer side of the tibiae is fringed with very long greyish-golden, silky hairs, and the tarsal joints have long spine-like tufts of greyish or fuscous hairs. *Abdomen* blackish; appendices of the ♂ somewhat testaceous; app. sup. elongately triangular, pointed, arising from each side of the middle of the margin of the last dorsal segment, fringed with long golden hairs; app. inf. thick, cylindrical, curved upwards, fuscous at the base, then testaceous, and black at the tips, fringed with long golden hairs; from the interior of the cavity of the last segment arises the long, triangular, yellow penis (or perhaps it is rather only the penis-cover), the apex of which is somewhat produced and notched, this member is concave beneath, and extends beyond the appendices."

"*Anterior wings* varying from dark golden brown to blackish fuscous, uniformly of one tint without markings (the ♀ always the darker), clothed with golden or fuscous pubescence (when the pubescence is removed, the membrane appears to be sprinkled with somewhat numerous, but indistinct, pale dots); fringes fuscous; veins brown, costa, subcosta, and radius darker, because thicker; upper branch of the ramus thyrifer, in that portion of it that forms the upper boundary of the cellula thyridii, whitish, semitransparent. *Posterior wings* smoky blackish, the veins darker; fringes blackish."

"I have examined six males and two females, sent to me by Mr. Henry Edwards, of San Francisco."

McLachlan's description may be supplemented as follows: posterior wing in both sexes bears a fringe of long, brown, silky hairs on the basal half of Cu_1, directed posteriorly.

Male Genitalia—fig. 19.—Ninth segment narrowed dorsally, fused to the tenth; lateral portion with a dense patch of hairs, ventral margin of sternite straight. Cerci short, compressed dorso-ventrally, triangular from above, each with a transparent finger arising from its mesal margin at base, fig. 19b. Tenth tergite forming a long, narrow hood, tapering towards apex, which is excised; upper surface sparsely clothed with short spinules. Aedeagus cylindrical, about as long as tenth segment, apex bearing a pair of membranous fingers, fig. 19c, and below them a short, lightly-sclerotized scoop. Claspers two-segmented; basal segment stout, directed dorsad and laterad, from lateral view gradually widened

apically, viewed dorsally, inner surface greatly dilated and clothed with dense black spinules; terminal segment small, more or less fused to basal segment, apex set with black spinules. Length of fore wing, ♂, 14 mm. Wing venation as in fig. 19.

Female Genitalia—fig. 20.—Eighth sternite narrowed ventrally, apical margin with a deep, narrow, median incision, extending to basal margin; shoulders of incision rounded, apical margin darkly pigmented and bearing short setae. Ninth tergite produced caudad, apico-mesal margin bearing two small projections, fig. 20b, rounded from dorsal aspect, triangular from the side; in lateral aspect tergite broad at base, ventral margin directed dorsad; sternite deeply impressed longitudinally, so that it is concave in ventral aspect, apical margin truncate with a deep, median, narrow excision. Tenth tergite consists of a pair of hairy, plate-like appendages, their lower margins more or less fused to ninth segment; from the side they are triangular and from above roundly trapezoidal. Vaginal structure shown diagrammatically in fig. 20d. Length of fore wing, ♀, 15 mm.

From the type series, "California, Edwards," a male, now mounted as a microscope preparation, and a female, with abdomen mounted in canada balsam, have been selected and designated holotype and allotype *Heteroplectron californicum* McLachlan, 1871.

Leptocella piffardii (McLachlan)

(Fig. 21)

1863. *Setodes piffardii* McLachlan, Ent. Ann., 1863: 160.
1899. *Leptocella piffardii* Banks, Trans. Amer. Ent. Soc., 25: 214.
1934. *Leptocella albida* form *piffardii* Milne, Studies, N. A. Trich., 1: 13.
1944. *Leptocella piffardii* Ross, Bul. Illinois Nat. Hist. Surv., 23(1): 301.

McLachlan's description is as follows:

"Length of body 4 lin., of antennae 18 lin., expanse 13 lin." "Ferruginous: Antennae very long, the joints in the basal third half yellow and half dark fuscous, the rest altogether guscous; legs pale ochreous; anterior wings whitish, with numerous grey, somewhat geminated transverse bands, and the apex clouded with grey; at the anal angle are two or three confluent blackish spots; apical cilia also blackish; posterior wings unicolorous snowy-white."

"Allied to *S. exquisita*, *albida* and *candida* (especially the first) but differs in the transverse bands being more numerous and gray instead of yellow. In all three species the anastomosis appears semicircular, owing to the arching of the adjoining veins."

To this may be added that the head, in ventral aspect, has the width of the eyes less than the distance between the eyes. Wings of the unique type are considerably denuded, to the naked eye the anterior wing appears to be pale greyish brown with numerous narrow transverse whitish bands; posterior margin beyond the arculus bears two or three darker brown spots. When examined under a lens, the markings are

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EXPLANATION OF PLATE VII

FIG. 18. *Neophylax concinnus* McL.; b, ♂ genitalia, lateral aspect; c, genitalia, dorsal aspect; d, genitalia, ventral aspect. FIG. 19. *Heteroplectron californicum* McL. male wings; a, ♂ genitalia, lateral aspect; b, genitalia, dorsal aspect; c, genitalia, ventral aspect, tenth segment omitted.

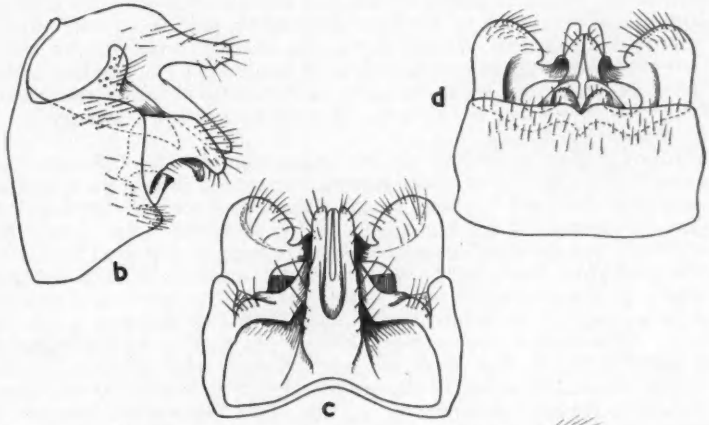

Fig. 18 concinnus ♂

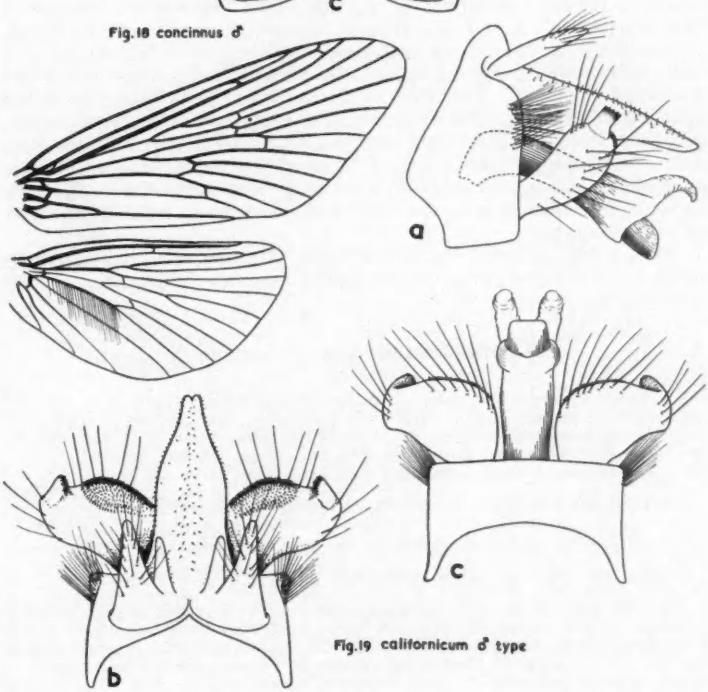

Fig. 19 californicum ♂ type

seen to be formed of pale brownish and white pubescence, the greyish appearance being due to the light filtering through the (now) sparse brownish pubescence. Membrane of the anterior wing clouded with pale brownish in the subcostal and radial areas, along Cu_1 and bordering the anastomosis, but with practically no indication of transverse bands. Length of fore wing, ♂, 13 mm. Wing venation and markings as in fig. 21.

Male Genitalia, fig. 21.—In the dried example, the abdomen was somewhat crushed to one of the posterior wings and some of the sternites have been devoured by insect pests. This is probably why McLachlan gave no description of the genitalia. After softening in hot water, the abdomen was separated from the posterior wing and cleared in KOH. The genitalia follow closely the pattern of *L. exquisita* Walker. Ninth tergite produced dorsally in an acute triangle, with traces of a pair of minute membranous projections at apex; laterally near base a pair of long fingers arise which are hairy and curved slightly ventrad; lateral margins produced as a short side-piece, fringed with bristles. Tenth tergite consists of a pair of slender plates, apices acute from the side, somewhat rounded from above; fig. 21c; from the ventral portion of these plates arises a pair of S-shaped, slender filaments with flattened, expanded apices, ventral surface squamosely rugose. Aedeagus short, stout, with a small, scoop-like terminal portion and a mass of inflated membrane above it. Claspers rather narrow, apices bifid, the lower fork dilated mesad as a flattened, rounded lobe; lower margin of clasper, from the side serrate, each tooth carrying a long bristle, fig. 21a. Between bases of the claspers arise a pair of short filaments, stouter than in *L. exquisita* and armed with three or four bristles; in the type, these filaments are asymmetric, one having a short basal branch, fig. 21b, the other simple.

NOVA SCOTIA: Type, ♂, Grand Lake, 20 miles from Halifax; presented by B. Piffard; now mounted as microscope preparations, wings mounted dry.

Lepidostoma podager (McLachlan)

(Fig. 22)

1871. *Nosopus podager* McLachlan, Jr. Linn. Soc. London, 11: 116.
1934. *Nosopus podager* Betten, New York State Mus. Bul. 292: 412, pl. 65, fig. 10.
1944. *Lepidostoma podager* Ross, Bul. Illinois Nat. Hist. Surv. 23(1): 258, 301.
1946. *Lepidostoma podager* Ross, Ann. Ent. Soc. Amer., 39: 282, fig. 11D.
1949. *Lepidostoma podager* Denning, Amer. Mid. Nat., 42(1): 121.

McLachlan describes the genus and species as follows:

EXPLANATION OF PLATE VIII

FIG. 20. *Heteroplectron californicum* McL.; a, ♀ genitalia, eighth to tenth segments, lateral aspect; b, ninth to tenth segments, dorsal aspect; c, eighth to tenth segments, ventral aspect; d, internal vaginal structure, ventral aspect. FIG. 21. *Setodes piffardii* McL. male wings; a, + genitalia, lateral aspect; b, clasper, ventral segment; c, tenth segment, dorsal aspect. FIG. 22. *Nosopus podager* McL. male wings; a, maxillary and labial palpi; b, scale from basal tarsal segment (enlarged); c, ♂ genitalia, lateral aspect; d, aedeagus, lateral aspect; e, genitalia, dorsal aspect; f, clasper, ventral aspect.

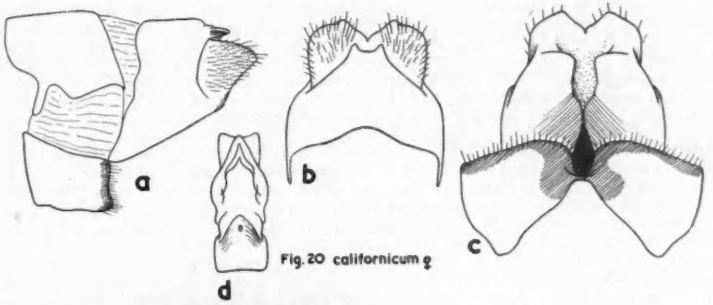

Fig. 20 californicum ♀

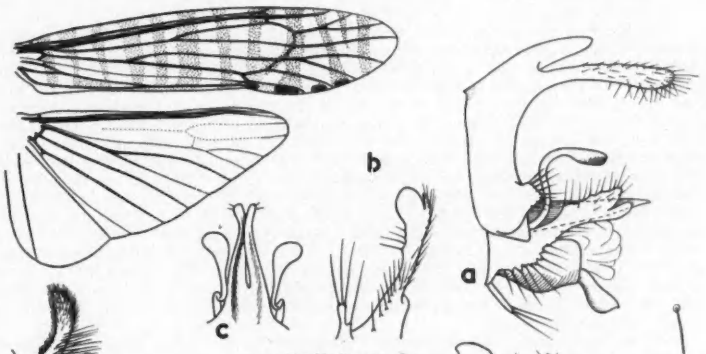

Fig. 21 piffardii ♂ type

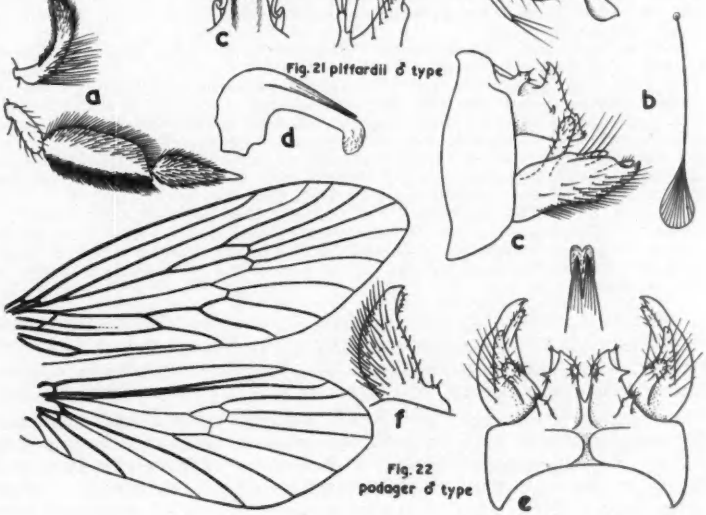

Fig. 22
podager ♂ type

"*Head* densely clothed with long hairs; antennae not so long as the wings, moderately stout, the apical half subserrate internally, basal joint nearly twice the length of the head, strong, hirsute, the succeeding joints short and transverse; eyes small and round; maxillary palpi very small, somewhat clavate, directed upwards and lying closely applied against the face, clothed externally with long and strong hairs; labial palpi very large and long, densely clothed with scales, the basal joint short, second very long, compressed and dilated, third about as long as second, and equally broad at base, but gradually acuminate to the apex. *Legs:* anterior pair abnormally constructed as follows: the coxa elongate, and ordinary; the trochanter small and cup-shaped; femur long, moderately slender, gradually diminishing from base to apex; tibia very short, sub-ovate, truncate, and dilated, slightly scaly, armed with one stout, claw-shaped spur; first joint of the tarsi enormously dilated, twice the length of the tibia, sulcate internally, the lower surface densely furnished with waxy-looking scales; succeeding tarsal joints short and small, gradually diminishing in length and thickness; intermediate and posterior legs slender, and of the ordinary form, each tibia furnished with an apical and subapical pair of long and equal spurs. *Abdomen* short and somewhat stout; inferior appendices short, curved.

"*Anterior wings* oval, rather densely clothed with short hairs, the fringes somewhat long; subcosta and radius nearly straight, parallel; discoidal cell narrow, closed by a straight veinlet; cellula thyridii very long, extending nearly to the base, and reaching to the middle of the discoidal cell, closed by a straight veinlet; a veinlet unites the lower fork of the ramus discoidalis with the ramus thyrifer, placed level with that closing the discoidal cell; an oblique veinlet beneath the middle of the cellula thyridii unites this with the cubitus anticus; seven apical cellules, the first extending along one-third of the upper edge of the discoidal cell, third shorter than the first, but longer than the second, fourth equal to the second, fifth longer than the first, extending to a level with the middle of the discoidal cell. *Posterior wings* moderately long, gradually dilated to beyond the middle, apex parabolic, costal margin with a short inturned fringe, anal portion with very long fringes; subcosta and radius united for some distance, afterwards separating and diverging; discoidal cell small, sub-triangular, closed by a straight veinlet; a second veinlet unites the lower edge of the discoidal cell to the ramus subdiscoidalis; lower branch of the ramus subdiscoidalis simple; ramus discoidalis simply and longly furcate."

"*Nosopus podager*. Dark fuscous. *Head* above, and basal joint of antennae, clothed with gray hairs, face and maxillary palpi with black hairs; antennae (except the basal joint) yellowish, with narrow fuscous rings; labial palpi densely clothed with reddish scales. Anterior legs reddish fuscous, the lower and outer side of the first tarsal joint with dense waxy-looking reddish scales; intermediate and posterior legs testaceous, the coxae fuscous. *Abdomen* fuscous, the margins of the segments greyish: from beneath the upper margin of the last dorsal segment proceeds a short, broad lobe, which ends in two updirected triangular pointed branches; app. inf. short, band-like, curved inwards, the apex toothed.

"*Wings* greyish-fuscous, sparingly clothed with dark grey hairs: in the anterior wings the pterostigmatical region with denser hairs; apical fringes grey; costal margin, and inner margin at base, with short blackish fringes: posterior wings with grey fringes, becoming blackish at the base of the costa: veins pale grey in all the wings."

To this the following may be added: the anterior tibia has two spurs, the dense clothing of waxy-looking scales is on the upper, not the lower, surface of the basal tarsal segment. Many of these scales have long filiform stems, apices clavate, very thin and longitudinally ridged, fig. 22b.

Male Genitalia, fig. 22.—Ninth segment short, upper surface depressed centrally to form a furrow between two rounded, opposing lobes. Tenth tergite hoodlike; from lateral aspect triangular, bearing a small process near base, dorsal margin produced dorsad as a strong acute tooth. Near base of this tooth there is a small conical process directed dorsad, apex bearing one or two small teeth; from dorsal aspect tergite deeply excised, lateral plates triangular, fig. 22c. Aedeagus,

fig. 22d, with stout base and slender stem, apex downturned and excised; lying along dorsal surface are a pair of flattened spines, fused basally. Claspers stout, hairy, nearly twice as long as tenth tergite, incurved and with acute, claw-like apices; dorso-mesal surface bears three digitate branches, the basal the longest, directed upwards, a second and third directed caudad; ventro-mesal margin bears a small projection near base, fig. 22f. Length of fore wing 9 mm. Wing venation as in fig. 22.

CALIFORNIA: (H. Edwards) 1♂. Type mounted as a microscope preparation.

Micrasema scissum McLachlan

(Fig. 23)

1884. *Micrasema scissum* McLachlan, Mon. Rev. Syn. Trich. Eur. Fauna, First Add. Suppl. 1884: 26, pl. 3, figs. 1–4.
1910. *Micrasema scissum* Martynov, Ann. Mus. Zool. Acad. Sci. St. Petersburg, 15: 360, figs. 9–10.
1941. *Micrasema scissum* Ross, Trans. Amer. Ent. Soc., 67: 115.
1944. *Micrasema scissum* Ross, Bul. Illinois Nat. Hist. Surv., 23(1): 303.
1947. *Micrasema scissum* Ross, Trans. Amer. Ent. Soc., 73: 157, 158, 163, figs. 43, 43A.

McLachlan describes *scissum* as follows:

"Black: head, basal joint of antennae, and apical portion of abdomen clothed with greyish-yellow hairs. Antennae uniformly blackish-fuscous. Palpi fuscous; a maxillary pair in the ♂ rather short, up-curved, the second and third joints nearly equal. Legs blackish-fuscous, the tarsi with a testaceous tinge. Abdomen blackish, with grey lateral lines. Wings somewhat elongate, pale grey, with short yellowish pubescence; pterostigmatic region darker and more opaque in the anterior wings; neuration fuscescent; in the anterior wings the discoidal cell is elongate and narrow; 1st apical fork very oblique at its base, 2nd apical fork with a long foot-stalk, 3rd apical fork sessile or nearly so; nervule closing the discoidal cell in an oblique line with that below it.

"In the ♂ the 9th dorsal segment is narrow, with a small median triangle; below it is the 'dorsal lobe,' *which is divided nearly to the base into two stout, slightly-curved, obtuse processes*. Intermediate appendages (?) testaceous, broad laterally, the apex strongly up-curved and furnished with three bristles proceeding from denticulations of the edge, and on the upper edge near the base are about four similar bristles and denticulations on a dilated portion of the appendage. Penis broad, flat, obtuse, placed below the last-named appendages. Inferior appendages large, widely divergent, rather narrow at the base, but gradually dilated, so that the extremities are broad and very obtuse, convex externally, concave internally, fringed with long yellowish hairs; on the upper edge near the apex there is a deep excision in which is a strong curved spine, and one or two ridges or teeth (but the precise conformation is difficult to distinguish). No ventral tooth.

"*M. scissum* may be readily distinguished from all described species of the genus by the peculiar anal appendages of the ♂. I know of no other species in which the 'dorsal lobe' is thus divided; in other respects there is no generic inconsistency."

To this is added a description of the ♂ genitalia.

Male Genitalia, fig. 23.—Ninth segment narrowed dorsally and ventrally; lateral margin bears an elongate hairy wart. Cerci moderately long, bluntly spindle-shaped from the side, seen from dorsal aspect their inner basal angles convergent. Tenth tergite forming a pair of plates, viewed from lateral aspect apices truncate, upper angles toothed, and with a number of small setiferous teeth on dorsal surface; from dorsal aspect fig. 23b, apices slightly divergent, outer margins produced and serrate. Aedeagus cylindrical, angled downwards about midway fig. 23a. Claspers stout and caliper-like; from lateral aspect dorsal

margin broadly rounded; seen from dorsal aspect inner surface gives rise to a short curved claw, apex directed mesad, but below the dorsal margin of the clasper; beyond this claw, there is a short, slender projection, directed mesad; from the base of each clasper there extends basally a slender dilated apodeme. Length of fore wing 7.75 mm. Wing venation as in fig. 23.

ALASKA: Behring Straits, St. Lawrence (or Clerk's) Island, 2. viii. 1897 (Baron Nordenskiöld, "Vega" Expedition). From the four cotypes in the McLachlan Collection a type has been selected and here figured. This is now mounted in canada balsam, one pair of wings mounted dry. Designated holotype of *Micrasema scissum* McLachlan, 1884. Further paratypes and the female allotype are presumably in the Stockholm Museum.

Sericostoma nigriculum (McLachlan)

(Fig. 24)

1871. *Notidobia nigricula* McLachlan, Jr. Linn. Soc. London, 11: 113, pl. 2, figs 5, 5a.
1934. *Agarodes nigricula* Betten, New York State Mus. Bul., 292: 393.
1943. *Notidobia arizonicum* Banks, Harvard Univ. Mus. Comp. Zool. Bul. 92: 369, figs. 94, 112, 137 (new synonymy).
1944. *Sericostoma nigriculum* Ross, Bul. Illinois Nat. Hist. Surv. 23(1): 303.
1944. *Sericostoma arizonicum* Ross, Bul. Illinois Nat. Hist. Surv. 23(1): 303.

McLachlan describes *nigriculum* as follows:

"Dull black. *Head* and *prothorax* above clothed with golden-yellow hairs; on the face the hairs are mostly blackish; antennae fuscous; palpi fuscous, clothed with fuscous hairs, the maxillary pair small, curved upwards, and closely applied against the face; eyes brown, somewhat coppery. Hinder margin of the meso- and meta-nota yellowish and shining. *Legs* obscure yellowish, with fuscous pubescence; all the coxae blackish, and the anterior femora, tibiae, and tarsi dark fuscous; spurs yellow, the pair on the anterior tibiae fuscous. *Abdomen* blackish fuscous, clearer beneath, clothed with black hairs; last segment above fringed with long, blackish, curved hairs: inferior appendices very large, longer than broad, yellow, concave internally, the superior margin rounded, apical margin produced into an incurvated tooth turned inwards, these appendices clothed externally and fringed with long blackish hairs; penis subobtuse, the point visible below the app. inf.

"*Anterior* and *posterior* wings uniformly fuliginous, subdiaphanous, clothed, but not densely, with short brownish pubescence, which becomes somewhat golden on the costal margin of the anterior wings; and in these wings the pterostigma is indicated by a narrow yellow space; fringes brownish-grey, becoming pale grey towards the anal angle of the posterior; veins fuscous."

To this is added the following:

Male Genitalia, fig. 24.—Abdomen clothed with long hairs, whose bases are surrounded by a hyaline spot. Ninth segment narrowed above and below, dorsal margin produced in a long narrow triangle, to which is fused the tenth segment; ventral portion, between claspers, produced

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EXPLANATION OF PLATE IX

FIG. 23. *Micrasema scissum* McL. male wings; a, ♂ genitalia, lateral aspect; b, genitalia, dorsal aspect; c, genitalia, ventral aspect. FIG. 24. *Notidobia nigricula* McL. male wings; a, ♂ genitalia, lateral aspect; b, genitalia, dorsal aspect; c, genitalia, ventral aspect. FIG. 25. *Notidobia griseola* McL.; a, ♂ genitalia, lateral aspect; b, clasper, dorsal aspect; c, ventral plate, ventral aspect.

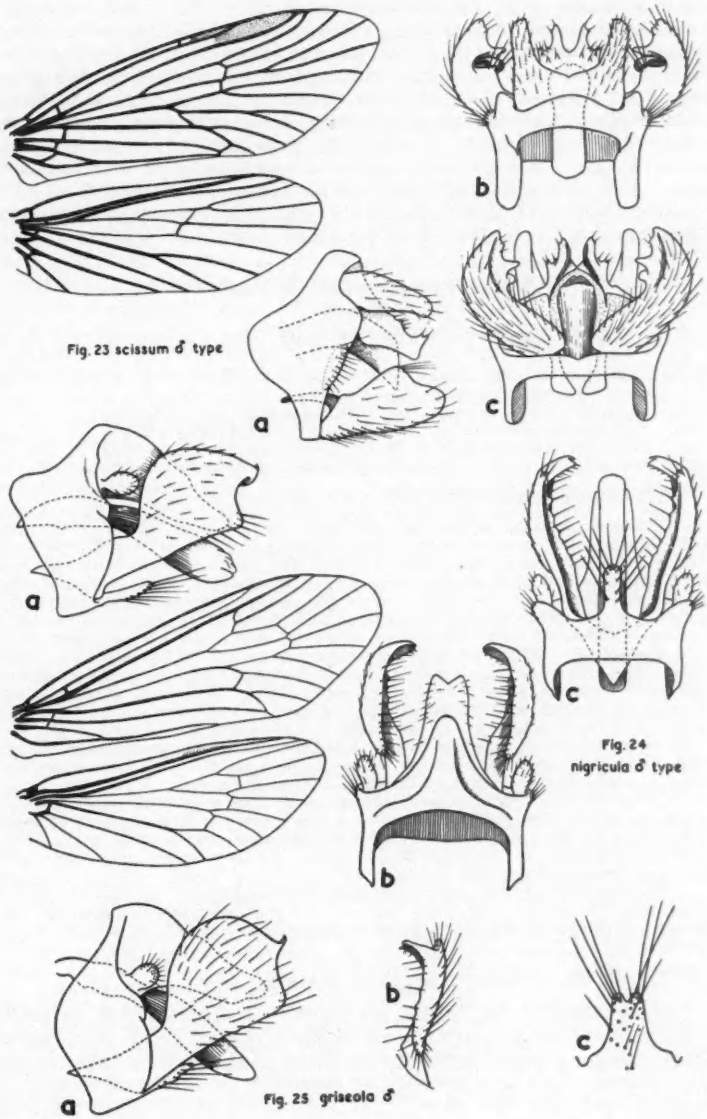

Fig. 23 scissum ♂ type

Fig. 24
nigricula ♂ type

Fig. 25 griseola ♂

as a long narrow plate, fringed with hairs, fig. 24c. Tenth segment long, hood-like, tapering towards apex, which is triangularly excised in dorsal aspect; dorsal surface near apex bears a number of short bristles, fig. 24b. Cerci small, flattened, auricular. Aedeagus simple, cylindrical. Claspers arise from a narrow stem, then are greatly expanded dorsad to form concave plates with excised apical margins; upper angle of the excision produced slightly dorsad, a small acute claw barely discernable; bases of the claspers internally fused to form a triangular plate with rounded apex. Length of fore wing 9 mm. Wing venation as in fig. 24.

CALIFORNIA: (H. Edwards), 1♂. Type in the form of a microscope preparation, with one pair of wings mounted dry.

Sericostoma griseolum (McLachlan)

(Fig. 25)

1871. *Notidobia griseola* McLachlan, Jr. Linn. Soc. London, 11: 112, pl. 2, figs. 4, 4a-c.
1907. *Notidobia assimilis* Banks, Proc. Ent. Soc. Wash., 8 (3–4): 124, pl. 8, fig. 8 (new synonymy).
1934. *Agarodes griseola* Betten, New York State Mus. Bul., 292: 393.
1934. *Agarodes assimilis* Betten, New York State Mus. Bul., 292: 393.
1944. *Sericostoma griseolum* Ross, Bul. Illinois Nat. Hist. Survey, 23(1): 303.
1944. *Sericostoma assimilis* Ross, Bul. Illinois Nat. Hist. Survey, 23(1): 303.

McLachlan describes the species as follows:

"Blackish fuscous. *Head* and *prothorax* clothed with whitish ashy-grey hairs, changing to fuscous on the face; antennae fuscous, paler and somewhat yellowish in some individuals; palpi fuscous, the maxillary pair in the ♂ very small and applied against the face; hinder margins of meso- and metanota yellowish. *Legs* yellowish; the anterior pair altogether fuscous, which colour sometimes pervades also the intermediate and posterior femora; coxae blackish-fuscous. *Abdomen* fuscous, sometimes yellowish, with a pale line along each side, and clothed with ashy-grey hairs: appendices of the ♂ yellow; app. inf. large, longer than broad, the apex truncate, the superior edge rounded, the apical margin furnished with an acute claw-shaped spine, which is turned inwards, these appendices fringed with yellowish-grey hairs; penis slender obtuse, straight, notched at the apex above. In the ♀ the abdomen is depressed, and at the apex is a large oval pouch, which is usually filled by a dark olive-green mass of eggs; but when empty the upper portion is seen to be furnished with a broad median lobe, on each side of which is a somewhat triangular valve.

"*Anterior wings* grey, densely clothed with ashy-grey pubescence, mingled with fuscous; in the ♂ there are two or three small elongate spaces of white pubescence on the inner margin, and an indication of whitish dots in the discal and apical portion of the wing; fringes grey. *Posterior wings* paler grey, with long grey fringes at the anal margin.

"I possess two males and five females, from California, sent by Mr. Henry Edwards: the females vary very much in size and comparative robustness, the larger individuals having the legs and antennae darker; but all seem to pertain to one species."

To this the following description is added:

Male Genitalia, fig. 25.—Very similar to *nigricula;* the following description is largely a comparison to that species. From lateral aspect basal margin of ninth segment evenly rounded. Cerci a trifle shorter and stouter than in *nigricula*. Ventral plate of ninth segment, from ventral view, fig. 25c, stouter, apex shallowly bifid. Claspers, from lateral aspect, wider than in *nigricula*, apical margin only slightly excised, although when seen from caudal view apical margin may appear

to be more deeply excised, owing to the concavity of the clasper; from dorsal aspect, fig. 25b, upper apical angle more abruptly inturned, forming almost a right-angle, tapering to a pair of acute spurs; lower apical angle projects as a short lobe. When viewed from lateral aspect fig. 25a, dorsal margin of clasper is more rounded, the apex forms an obtuse angle with apical margin rather than almost a right angle as in *nigricula*. Length of fore wing, ♂, 10.5 mm.

CALIFORNIA, (H. Edwards).

Of the original seven specimens mentioned by McLachlan, only two males and three females can now be recognized with certainty. There was in the McLachlan Collection a third male, with the same data and bearing his determination and type labels, but this example must be considered as a subsequent addition and is in fact a male of *nigricula*. There are two other females, but these bear neither type nor determination labels by McLachlan, it has been considered wiser to disregard them as part of the type series, bearing in mind the evidence offered by the surplus male just mentioned. One of the two cotype males has been mounted as a microscope preparation, forming the basis of the present figures, and is here designated as type. In view of the variation in the females mentioned by McLachlan, and of the similarity between the males of *griseola* and *nigricula*, it is not proposed to designate an allotype for, or to figure the female genitalia of *griseola*, as it seems preferable to wait until evidence is available of pairs taken in copula.

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PLANT GROWTH SUBSTANCES, edited by FOLKE SKOOG. xiv+476 pages, illustrated. University of Wisconsin Press. 1951. Price, $6.00.

There are forty contributors to this volume, each covering a separate aspect of the general subject. Topic headings include: Plant growth substances, growth substances in plant metabolism, Tissue responses to growth substances, Practical applications of growth regulators, Growth substances in vegetative development, Growth substances in reproductive development, Growth substances in pathalogical growth, Vitamins and amino acids as growth factors.

The work of the authors in presentation of the individual papers is, in general, very good, as is the overall editing. The book summarizes twenty years of plant hormone work, beginning with the initial work in European laboratories and bringing up to date the developments in the various fields where the basic principles can be extended or applied. One of the chief values of the book rests in the fact that many of the forty authors of papers have been responsible for continued development of the field since its beginning.

The sections on tissue response and pathological growth will be of special interest to entomologists, as they present the basic reactions of tissues to the known stimulations of chemicals, organisms, extractives, etc.

It is true that most of the work reported is in the developmental phase, stressing descriptions more than mechanisms. This is inevitable in a youthful field, but rapidity of progress in this area has brought knowledge to the challenging phase where mechanisms can be postulated with value. The completeness of coverage of all phases of knowledge of plant growth substances makes this book a very valuable one. The references cited in each of the forty papers collectively constitute a rather complete coverage of the literature on plant hormones.

—A. BIDDULPH.

WASP VISITORS OF TULIP-TREE HONEYDEW AT DUNN LORING, VIRGINIA

(Hymenoptera Aculeata)

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While it is rather generally known among collectors that the honeydew secretions of many aphids and scales are extremely attractive to wasps, I am not aware that any list[1] has been published of the species collected on these secretions of the tulip-tree[2] scale, *Toumeyella liriodendri* (Gmel.). This large hemispherical scale, found on the bark, exudes a copious amount of honeydew which covers the leaves, twigs and ground beneath. Although the leaves of the tulip-tree have a very aromatic odor, this is not the attractant for scale-free trees have practically no visitors. The honeydew is produced throughout the collecting season so it is possible to obtain a succession of visitors which cannot be gotten by flower collecting.

During the summer of 1949 I devoted some hours of my rather limited collecting time to the tulip-tree. Since only 13 afternoons, at more or less weekly intervals from the end of May through the middle of September, were spent in the field, and only a part of that time at the tulip-trees, the collecting may truly be said to have been discontinuous and not reflecting a complete picture of the total number of species which could have been obtained had unlimited time been available. The total of 93 species collected at tulip-tree honeydew during 1949, compared with the 176 species of wasps, in the families listed, collected during the past three years in a variety of situations in the same limited locality, is a favorable measure of the excellent results which could be obtained by more thorough collecting.

Collecting was done entirely near Dunn Loring, Virginia, a small community located some ten and a half miles west of the Zero Milestone in Washington, and about two and a half miles WNW of Falls Church, Virginia. The particular area in which I have concentrated my collecting activities for the past three years, is a small tract of 20 acres of second-growth woods bearing principally *Quercus marilandica* Muench., *Q. montana* Willd., and pine, with sparse ground cover of Ericaceae. The soil is clayey, quite gravelly and, in most of the area, rather densely covered with leaf litter. A small cleared, depressed area of several acres in extent occurs at one edge of the woods, the depression caused

[1]An earlier hymenopterist in the Washington area, Nathan Banks, found tulip-tree honeydew collecting profitable as evidenced by the number of wasps described by him and others from specimens which bear this label. It is unfortunate that Mr. Banks never gave us a list of the species he obtained on tulip-tree, as he did for *Ceanothus* (Ent. News 23: 102–110, 1912), for many of his favorite collecting spots, representing diverse ecological niches, have now been eliminated by the expanding metropolitan area.

[2]*Liriodendron Tulipifera* L. of the Magnoliaceae.

by the removal of several feet of the topsoil for the gravel. A group of about a dozen scale-infested tulip-trees, varying from 10 to 30 feet in height, is located at the edge of the clearing, and the wasps listed below were collected from and beneath this group of trees.

Some wasps, such as the species of *Vespula*, *Chalybion* and *Sceliphron*, visited the twigs, leaves and ground indiscriminately, and by their great numbers, large size and ceaseless activity, frightened away many of the more desirable species. Pompilidae, female Mutillidae, *Miscophus*, *Lyroda* and *Motes*, almost without exception, were found on the ground beneath the trees. *Polistes* and *Oxybelus* were most commonly found on the twigs, as was also the single *Psammaletes*. Male Mutillidae were usually found on the leaves, though some were to be found on the ground occasionally. Most of the other forms listed below seemed to prefer visiting the secretions on the leaves; this was particularly noticeable with *Trypoxylon* and almost all Crabroninae and Eumeninae.

In the appended list I have indicated the number of specimens captured of each species by number in parentheses following the author's name, except in the case of very common forms where no attempt was made to collect every individual seen. In most cases where a species was taken more than three times both sexes were present. I am indebted to H. E. Evans and H. K. Townes for confirming or making determinations in the Pompilidae.

Family Tiphiidae

Tiphia inaequalis Mall. (1)
T. intermedia Mall. (2)
Myrmosa unicolor (Say) (1)

Family Mutillidae

Ephuta scrupea (Say) (2)
E. pauxilla Brad. (2)
Timulla v. vagans (F.) (3)
T. dubitata fugitiva Mick. (7)
Pseudomethoca frigida (Sm.) (3)
P. simillima (Sm.) (4)
Dasymutilla nigripes (F.) (1)
D. vesta (Cr.) (2)
D. bexar (Bl.) (1)
D. rubricosa Mick. (2)
D. permista Mick. (5)
D. cypris (Bl.) (1)

Family Vespidae

Vespula maculifrons Roh. (common)
V. rufa vidua (Sauss.) (common)
V. maculata (L.) (common)
V. arenaria (F.) (common)
Polistes f. fuscatus (F.) (common)
P. f. pallipes Lep. (common)
Zethus variegatus Sauss. (1)
Eumenes globulosus Sauss. (2)
Monobia quadridens (L.) (common)
Rygchium f. foraminatum (Sauss.) (5)
Stenodynerus pedestris (Sauss.) (7)
S. perennis (Sauss.) (2)
S. fundatiformis gonosceles R. Boh. (2)
S. sp. (1)
Ancistrocerus antilope (Panz.) (1)
A. campestris (Sauss.) (1)
Symmorphus canadensis (Sauss.) (5)

Family Pompilidae

Aporus niger (Cr.) (1)
Evagetes parvus (Cr.) (2)
E. ingenuus (Cr.) (1)
Anoplius atrox (Dahlb.) (4)
A. splendens (Dreisb.) (3)
A. percitus Evans (5)
A. ventralis (Bks.) (1)
A. imbellis Bks. (4)
A. virginiensis (Cr.) (20)
Aporinellus completus Bks. (1)
Priocnemis germana (Cr.) (1)
Priocnemioides unifasciatus (Say) (9)
Priocnessus nebulosus (Dahlb.) (1)
Phanagenia bombycina (Cr.) (2)
Ageniella partita Bks. (1)
Minagenia sp. (1)
Auplopus subcorticalis (Walsh) (2)
Ceropales femoralis Cr. (5)
C. fraterna Sm. (2)

FAMILY SPHECIDAE

Sceliphron caementarium (Dru.) (common)
Chalybion californicum (Sauss.) (common)
Chlorion abdominalis (Cr.) (1)
C. harrisi Fern. (common)
Trypoxylon politum Say (common)
T. striatum Prov. (common)
T. clavatum Say (common)
T. carinatum Say (1)
T. johnsoni Fox (1)
T. backi Sandh. (1)
T. pennsylvanicum Sauss. (3)
T. frigidum Sm. (common)
Astata leuthstromi Ashm. (1)
Lyroda subita (Say) (8)
Miscophus americanus Fox (7)
Tachytes mandibularis Patt. (1)
Tachysphex similis Roh. (4)
T. terminatus (Sm.) (3)
T. sp. (4)
Motes argentatus (Beauv.) (2)
Alysson melleus Say (1)
Nysson opulentus Gerst. (1)
Ochleroptera bipunctata (Say) (2)
Psammaletes pechumani (Pate) (1)
Psammaecius pergandei (Handl.) (3)
Gorytes simillimus Sm. (2)
Diodontus trisulcus (Fox) (1)
Psen johnsoni (Vier.) (2)
Passaloecus relativus Fox (1)
P. annulatus (Say) (1)
Xylocelia virginiana Roh. (1)
Stigmus fraternus Say (4)
Ectemnius stirpicolus (Pack.) (5)
Lestica producticollis (Pack.) (6)
Entomognathus lenapeorum Vier. (5)
Crossocerus lentus (Fox) (2)
C. similis (Fox) (1)
C. tarsalis (Fox) (1)
C. nitidiventris (Fox) (1)
Crabro snowii Fox (1)
C. sp. (2)
Oxybelus intermedius Baker (5)

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As was announced in the report of the Managing Editor for 1949 (Ann. Ent. Soc. Amer. 43: 163, 1950) the University Microfilms, Ann Arbor, Michigan, is making microfilm copies of the ANNALS, to go to members and *bona fide* subscribers only and for their exclusive use. Costs of this service may be obtained on application to University Microfilms. The main purpose of these microfilms is to provide a cheaper method, with saving of space and binding, for preserving back volumes in libraries, thus releasing current copies for current use. Microfilms are made black on white (not negative prints). A copy of volume 42 which was sent to me seems wholly satisfactory.—EDITOR.

THE TAXONOMY AND BIOLOGY OF PSOROPHORA (JANTHINOSOMA) JOHNSTONII (GRABHAM, 1905)[1]

(Diptera: Culicidae)

ERNESTINE B. THURMAN,[2] JAMES S. HAEGER,
AND
JOHN A. MULRENNAN

The problem of mosquito control in the Florida Keys is complicated by the presence of appreciable populations of such species as *Anopheles albimanus* Wiedemann, *Aedes tortilis* (Theobald), *Culex atratus* Theobald, *Culex bahamensis* Dyar & Knab, and *Psorophora johnstonii* (Grabham) which are unknown as prolific breeders elsewhere in the United States. In connection with intensive mosquito survey work in the Florida Keys during 1947 and 1948, information has been accumulated concerning the taxonomy, biology, and pest importance of *Psorophora johnstonii* (Grabham). As the literature is somewhat confused and incomplete, a discussion of the taxonomic position of this mosquito is presented first, in order that the reader may be properly oriented before continuing with the notes on the biology of the species.

Psorophora (Janthinosoma) johnstonii (Grabham, 1905)

Janthinosoma johnstonii Grabham, 1905, Can. Ent., 37: 410.
Janthinosoma varipes (Coquillett). Coffin, 1905 (not Coquillett), *in* Shattuck, The Bahama Ids., p. 281.
Culex cyanescens (Coquillett). Coffin, 1905 (not Coquillett), *in* Shattuck, The Bahama Ids., p. 293.
Janthinosoma schwarzi Dyar & Knab, 1906, Proc. Biol. Soc. Wash., 19: 135.
Janthinosoma varipes (Coquillett). Coquillett, 1906 (in part, not Coquillett), U. S. Dept. Agr., Bur. Ent., Tech. Ser. 11: 17.
Janthinosoma coffini Dyar & Knab, 1906, Proc. Biol. Soc., Wash., 19: 134 (new synonymy).
Janthinosoma varipes (Coquillett). Theobald, 1907 (in part, not Coquillett), Mon. Culic., 4: 154.
Aedes schwarzi (Dyar & Knab). Pazos, 1909, San. y Ben., ii, 46: 317.
Janthinosoma varipes (Coquillett). Pazos, 1909 (not Coquillett), San. y Ben., ii, 51: 680.
Janthinosoma varipes (Coquillett). Theobald, 1910 (in part, not Coquillett), Mon. Culic., 5: 121.
Janthinosoma schwarzi Dyar & Knab. Theobald, 1910, Mon, Culic., 5: 604.
Janthinosoma coffini Dyar & Knab. Theobald, 1910, Mon. Culic., 5: 603.
Psorophora johnstonii (Grabham). Howard, Dyar & Knab, 1917, Carnegie Inst. Wash. Pub. 159, 4 (2): 572.
Psorophora coffini (Dyar & Knab). Howard, Dyar & Knab, 1917, Carnegie Inst. Wash. Pub. 159, 4 (2): 574.

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Psorophora coffini (Dyar & Knab). Dyar, 1921, Insecutor Inscitiae Menstruus, 9:31.
Psorophora (*Janthinosoma*) *johnstonii* (Grabham). Dyar, 1928, Carnegie Inst. Wash. Pub. 387: 121.
Psorophora (*Janthinosoma*) *coffini* (Dyar & Knab). Dyar, 1928, Carnegie Inst. Wash. Pub. 387: 121.
Psorophora varipes (Coquillett). King, Bradley & McNeel, 1939 (in part, not Coquillett), U. S. Dept. Agr. Pub. 336: 50.
Psorophora coffini (Dyar & Knab). Pratt, 1946, Proc. Ent. Soc. Wash., 48: 209.

Synonymy.—

Psorophora (*Janthinosoma*) *johnstonii* (Grabham, 1905) was described from four females taken on a horse along the Molynes Road, Kingston, Jamaica, early in July, 1905 (see Grabham, 1905). The species was described as having a small white knee spot, the third hind tarsus completely white except for a few apical black bristles, and as being 4.5 mm. in body length. The redescription of the species by Howard, Dyar & Knab (1917, p. 572) reads, ". . . tips of middle and posterior femora rather broadly white scaled; . . . penultimate joint of hind tarsi white except at its tip; and body about 4.5 mm." Dyar (1928) deviated slightly from the earlier descriptions by describing the female as having the tips of the hind tibiae with small patches of gray-white scales and the fourth hind tarsal segment white except at its tip. The body measurement of the female was disregarded.

Janthinosoma schwarzi Dyar & Knab, 1906, listed as a synonym of *P. johnstonii* by Howard *et al.* (1917), was described from one female taken at Cayamas, Cuba, May 7, 1906, by E. A. Schwarz. The description is (p. 135): "As in *J. coffini* Dyar & Knab, but the tips of the hind femora are pure white."

Janthinosoma coffini Dyar & Knab, 1906 was described from eight females collected at Nassau, Bahamas, B. W. I., June 22, 1903, by T. H. Coffin. The description includes (p. 134): ". . . tips of mid and hind femora dusky; penultimate joint of hind tarsi white, the last dark." The body length is given by Howard *et al.* (1917) as 3.5 mm. *Culex cyanescens* Coffin, 1905 (not Coquillett) recorded from Tarpum Bay is a synonym of *coffini*, the noted variation being the hind tarsal segments with all dark scales, according to the same authors, by whom *P. coffini* is considered closely allied to *johnstonii* but differing in size and minor colorations. Dyar (1928) stated that *coffini* is a smaller species than *johnstonii* and does not show a white tip to the hind femora, and that both species represent the South American *discrucians* and not the North American *varipes*, which has a broad area of black scales in the middle of the mesonotum, including the scutellum. Pratt (1946, p. 209) described *coffini* as a "rather small mosquito, 1.5 mm. long, with the (quoting from Dyar, 1928, p. 108) 'hind femur indistinctly white-tipped'." Specimens from the type locality measured 3.5 and 4 mm. Pratt continued by mentioning a series of mosquitoes collected from Portland Ridge, Jamaica, B. W. I., some 40 miles west of the type locality of *johnstonii*, from Ponce, P. R., and from Culebrita, P. R., which were considerably larger and stouter, (3 mm. long) with the more distinctly white-tipped hind femur characteristic of *johnstonii*. The specimens from the three localities were collected within a mile of coastal mangrove-swamps. However, larvae of *coffini* which Pratt described, keyed,

and figured in 1946, were collected 3 miles inland on St. Croix, Virgin Islands. The females reared from these larvae were noticeably smaller than the type specimens of *johnstonii*. Pratt failed to mention the absence or presence of knee spots on these reared females of *coffini*.

The probability of the misidentification of a female *P. varipes* (Coquillett) as recorded from Matecumbe Key by King, Bradley & Mcneel (1939) was noted by Pritchard, Seabrook & Mulrennan (1947).

It has been the privilege of the authors to compare specimens of male and female adults, male terminalia, and larvae of *coffini* and female adults of *johnstonii* (loaned by Dr. Alan Stone, U. S. National Museum, and Dr. Harry D. Pratt, U. S. Public Health Service), females of *varipes* (loaned by Dr. W. V. King, U.S.D.A., Bureau of Entomology and Plant Quarantine, and Dr. W. W. Wirth, University of California) with the reared male and female adults, male terminalia, and larvae of *johnstonii* from the Florida Keys. Comparative data and conclusions from this study of Florida *johnstonii* are presented with a description of the male and immature stages.

Four female specimens of *coffini* taken on the Virgin Islands showed both large and small knee spots, with the fourth hind tarsal segments being more than four-fifths white-scaled, although all specimens in the group had a few dark scales at the apex of the segment. Of two topotype specimens from the Bahama Islands, one showed a large knee spot and an all dark-scaled fourth hind tarsal segment; the second specimen had a small knee spot, and the fourth hind tarsal segment white-scaled on the basal one-half of the outside and all dark-scaled on the inside. The sizes of these *coffini* specimens ranged from 2 to 4 mm.[3]

Of ten female specimens of *johnstonii* from Culebrita and Ponce, P. R., seven had small knee spots, and three were without knee spots. The fourth hind tarsal segments varied from four-fifths to completely white-scaled. One large female specimen from Jamaica, 5 mm. long, had a large knee spot with an all white-scaled fourth hind tarsal segment. A medium-sized specimen from Cuba, in the National Museum Collection, had a large knee spot and a white fourth hind tarsal segment except for a few dark scales at the apex.

In a Florida 1947–48 *johnstonii* series of 73 females (34 reared) and 31 males (29 reared) variations from completely dark knees to large knee spots were noted. The fourth hind tarsal segments exhibited 14 different variations in combinations of dark and light scaling from all dark to completely white-scaled; some specimens were dark-scaled inside with varying degrees of white scaling on the outside, and of these, two specimens had a small basal white spot on the outside. The majority of the specimens possessed segments that were from three-fourths to four-fifths white-scaled. Measurements of the length of the specimens varied from 2 to 5 mm. with apparently little size relationship as to sex, knee spotting, and tarsal markings. Re-examination of the available specimens collected by A. E. Pritchard and E. L. Seabrook during 1945 showed the specimens to be of the small and medium sizes, with both large and small knee spots, and with widely varied coloration markings on the fourth hind tarsal segments.

[3]Measurements include length of abdomen plus thorax, rather than only the abdomen as "body length" of earlier authors indicates.

Reexamination of three female specimens of *varipes* (loaned by Dr. King) demonstrated that two from Lot No. 2076 compared favorably in size and coloration with the specimens known to be *johnstonii* from the Keys. The third specimen, Lot No. 2019, was in too poor condition to determine the species. As the specimens were without collection data, it was impossible to ascertain if these specimens were the ones from Matecumbe Key on which King, Bradley & McNeel (1939) based their record.

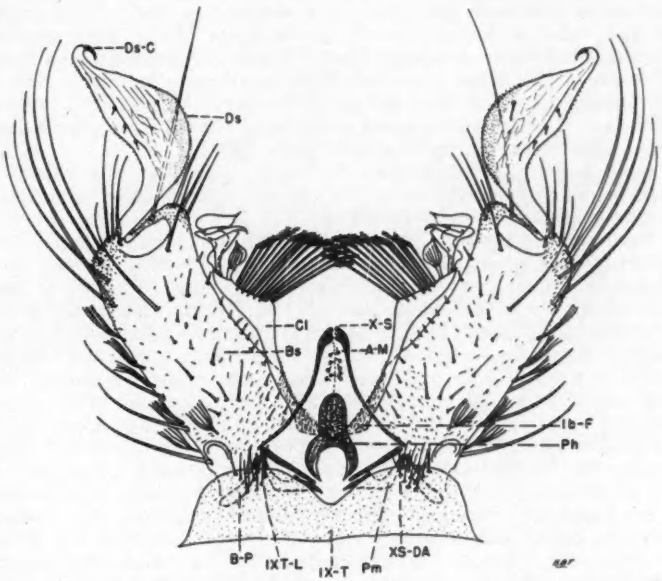

FIG. 1. *Psorophora* (*Janthinosoma*) *johnstonii* (Grabham, 1905). Structure of male terminalia.

Legend:*

IX-T.—Ninth tergite.
IXT-L.—Ninth tergite lobes.
X-S.—Tenth sternite.
XS-DA.—Dorsal arm of Tenth sternite.
A-M.—Anal membrane.
Ph.—Phallosome.
Ib-F.—Innerbasal fold.
Pm.—Paramere.
B-P.—Basal plate.
Bs.—Basistyle.
Cl.—Claspette.
Ds.—Dististyle.
Ds-C.—Claw of dististyle.

Examination of larval skins of *coffini* collected at St. Croix, V. I., December 18, 1945 (Pratt), displayed no major taxonomic differences from the larvae collected in Florida from which males and females of *johnstonii* were reared. Pratt (1946) adequately described and keyed

*Morphological terminology used is that employed by Carpenter, Middlekauff & Chamberlain (1946).

the larva of *coffini* and presented excellent figures of the structural parts. Inasmuch as the description has been recorded for *coffini*, a synoptic description with only the recognition larval characters listed is presented with the correct name, *johnstonii*.

Mounted specimens of the male terminalia of *johnstonii* from Florida compared with one specimen of *coffini* collected by Dr. Peterson, St. Thomas, V. I., November 5, 1920, appeared to be identical except for slight variations in the number of apical teeth of the tenth sternite. The Florida material showed from 2 to 4 teeth, a variation which included the two teeth present on the specimen of *coffini*. Dyar (1928) described *coffini* as having a tooth at the point of the tenth sternite. Dyar described the male of *coffini* in 1921 and in 1928 presented a figure and a key. The figure presented seems inadequate in that it fails to show clearly in detail the tenth sternite, ninth tergite, and internal structures. Herewith is included a description of the male of *johnstonii* and an illustration of the structural parts (fig. 1).

Since previous authors have sufficiently described the female of *johnstonii* with the exception of the variations which have been noted, only recognition characters are listed.

Taxonomic Conclusions.—From the foregoing information it is apparent that specimens of *johnstonii* from Florida, Puerto Rico, Jamaica, and Cuba may have dark knees, or knees with small or large spots of white, or dull-white scales. The Florida specimens showed variations in the fourth hind tarsal segment from all dark to all white-scaled. Specimens of *coffini* from the Virgin Islands and the Bahama Islands had both large and small knee spots, while the fourth hind tarsal segments varied in coloration from all dark to all white scaled. Although the Puerto Rican, Jamaican, and Cuban specimens of *johnstonii* were larger than those of *coffini* from the Bahama and Virgin Islands, the Florida *johnstonii* included the size range of *coffini*. In view of the fact that the Florida material, which has been demonstrated to be *johnstonii*, contained specimens which included all variations shown in *coffini* and *johnstonii* from their type localities, Dr. Stone, Dr. Pratt, Mr. Thurman, and the authors believe *johnstonii* and *coffini* to be synonymous and the name should be *johnstonii* due to its earlier date of description.

Adult Female.—Small to medium size, 2 to 5 mm. *Proboscis:* Entirely black with purplish reflections. *Mesonotum:* Integument dark; with scattered dull white appressed scales, dull golden erect scales and a few dark setae, all intermixed with golden-bronze narrow scales in an indefinite pattern antero-medially; grayish-silver, broader scales scattered postero-laterally; pleura with white broad scales and light setae lending a rough appearance. *Abdomen:* Dorsally segment I white-scaled, segments II to VII purple-scaled with lateral triangular patches of white scales apically; ventrally segments golden-scaled except for segment VII being purple. *Femora:* Light-scaled basally, purplish on apical third, white apex (knee-spot). *Tibiae:* Purplish. *Tarsi:* Purplish, basal four-fifths of fourth hind segment usually white scaled, varying to entirely dark or entirely white.

Adult Male.—Coloration similar to that of female. Terminalia (fig. 1): *Ninth tergite* (IX–T): Broad, well developed *lobes* (IXT–L)

rounded apically, each with 9 to 12 setae. *Tenth sternite* (X–S): Heavily sclerotized, bearing 2 to 4 apical points; five small setae on apical third of *anal membrane* (A–M). *Dorsal arm* (XS–DA): Sclerotized, straight, long. *Phallosome* (Ph): Heavily sclerotized, conical, rounded apically, slightly narrowed medially, broad and rounded basally, open ventrally, closed dorsally. *Paramere* (Pm): Sclerotized, boomerang-shaped, a median point on inner margin of basal half. *Basal plate* (B–P): Sclerotized, gently curved laterally, rounded at points, basal point slightly expanded. *Innerbasal fold* (IB–F): Weakly sclerotized, finely spiculated. *Claspette* (Cl): Slender, three-fourths

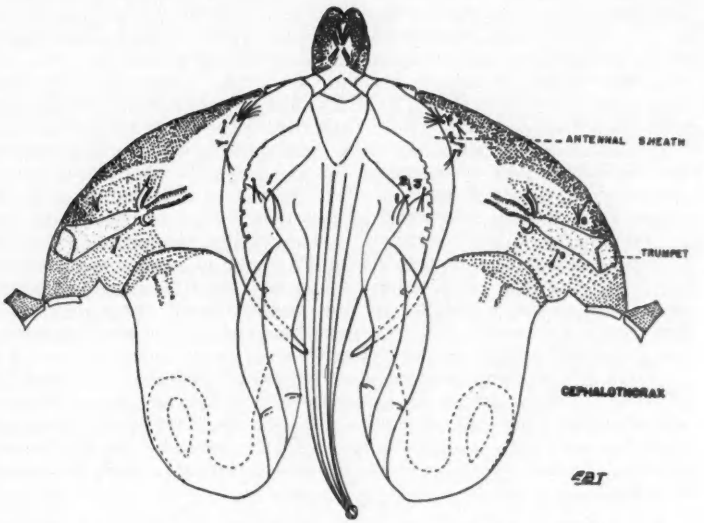

FIG. 2. *Psorophora* (*Janthinosoma*) *johnstonii* (Grabham, 1905). Structure and chaetotaxy of cephalothorax of pupa. The terminology is that employed by Knight and Chamberlain (1948).

as long as basistyle, basal one-half finely spiculated and apical one-half not attached to basistyle, expanded on apical one-third, tapering to tip; the expanded inner area with 16 to 18 slender filaments, bent or curved at apical fourth, tips minutely fimbriated; a large leaf-like, spiraled, pointed filament at apex; a second less contorted, broad, pointed filament placed just ventrad; a shorter, broad, leaf-like striated filament sub-apical. *Basistyle* (Bs): About 2.5 times as long as broad, sides nearly parallel, slightly concaved medially, truncate at apex, clothed with scales, fine spiculations, and long curved setae, the setae being longer and more numerous at apex. *Dististyle* (Ds): About three-fourths as long as basistyle, basal one-third constricted, reticulations running parallel with outer margin on the inflated medial portion, fine spiculation on inner margin, abruptly tapered preapically; a heavy,

pointed *claw* (Ds–C) inserted at the hook-like apex; three setae located medially along a heavy reticulation, interior and subparallel to outer margin; one seta located slightly beyond middle, near the inner margin.

Pupa (figs. 2 and 3).—Small, light brownish. *Cephalothorax:* Dark brown area postero-dorsal to trumpet. *Trumpet:* Dark brownish-yellow, approximately 2½ times as long as wide, hexagonal reticulations and fine spiculations on surface, pinna fringed. *Head shield:* Twice as long as wide. *Palpal case:* External margin with rounded point medially. *Metanotum:* Median bar rounded, distinct, lateral creases complete; chaetotaxy as featured in fig. 2. *Abdomen:* Approximately 3½ times as long as wide; segments III to VII with dorsal medial light triangles (more apparent on pupal skins). Chaetotaxy as featured in fig. 2. *Paddle:* Not pigmented, external border weakly sclerotized; midrib extending nearly to apex; hair No. 8 long, slender.

Larva.—Long antennae; inflated air tube. *Head:* Broader than long; antennal tufts multiple, medially placed; upper head hairs double; lower head hairs double or triple, both with inner branches shorter than outer branches; preantennal tufts multiple. *Abdomen:* Integument smooth; lateral hairs on segments III to VI usually multiple, single on segment VII; comb of segment VIII with 5 to 7 scales on posterior margin of a weakly sclerotized plate, each with a central spine, one or two smaller lateral teeth and three to five progressively smaller denticles. *Air tube:* Inflated, 2.5 to 3.5 times as long as basal width; 3 to 8 pecten teeth. *Anal segment:* Longer than wide, ringed by sclerotized plate, plate perforated by the ventral brush along midventral line; lateral hair small, double or multiple; anal gills normal, tapering, 2 to 4 times the length of the segment.

Egg.—Black, shiny, elongate-oval; diagonal rows of clear stump-like tubercles covering almost the entire chorion, denser at apex. External egg structure (fig. 4): *Anterior pole* (A–P): Narrowed, elongated, neck-like, without protuberances. *Dorsal surface* (D–S): Slightly convex. *Ventral surface* (V–S): Swollen anteriorly, sharply tapered posteriorly.

KEY TO THE SPECIES OF THE SUBGENUS JANTHINOSOMA OCCURRING IN FLORIDA[4]

Adult Females

1. All tarsi entirely dark-scaled (may occur rarely in *johnstonii*), **cyanescens** (Coquillett)
   All tarsi not entirely dark-scaled 2
2. Fourth hind tarsal segment white-scaled, fifth dark 3
   Fourth and fifth hind tarsal segments white-scaled 4
3. Mesonotum with longitudinal dark-scaled area ..... **varipes** (Coquillett)
   Mesonotum without longitudinal dark-scaled area ..... **johnstonii** (Grabham)
4. Mesonotum uniformly covered with intermixed dark brown and golden scales ..... **ferox** (Humboldt)
   Mesonotum with broad median longitudinal stripe and dark bronzy-brown scales, with pale yellow or white scales laterally ..... **horrida** (Dyar & Knab)

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[4]Couplets of these keys are modified from those of Dyar (1928), King, Bradley & McNeel (1944), Matheson (1944), Carpenter, Middlekauff & Chamberlain (1946), Roth (1945), and Pratt (1946) with original couplets for distinguishing *johnstonii*.

Male Terminalia

1. Claspette rigid, straight . . . . . **varipes** (Coquillett)
   Claspette curved 2
2. Claspette attached to basistyle . . . . . **cyanescens** (Coquillett)
   Claspette not completely attached to basistyle 3
3. Basistyle 3 to 3.5 times as long as wide, tenth sternite with four or five points, phallosome pointed at apex . . . . . **ferox** (Humboldt)
   horrida (Dyar & Knab)[5]
   Basistyle 2.5 times as long as wide, tenth sternite usually with three points, phallosome rounded at apex . . . . . **johnstonii** (Grabham)

Larvae

1. Upper and lower head hairs single . . . . . **cyanescens** (Coquillett)
   Upper and lower head hairs double or triple 2
2. Antennae distinctly longer than median length of head . . . . . **ferox** (Humboldt)
   Antennae hardly ever longer than median length of head 3
3. Comb scales of eighth abdominal segment numbering four or five, **varipes** (Coquillett)
   Comb scales of eighth abdominal segment numbering five to eight 4
4. Lower head hairs extending to base of antennae, siphon 3.5 times as long as basal width . . . . . **horrida** (Dyar & Knab)
   Lower head hairs extending beyond base of antennae, siphon 2.5 times as long as basal width . . . . . **johnstonii** (Grabham)

BIOLOGY

Psorophora (*Janthinosoma*) *johnstonii* (Grabham, 1905) had been known only from the Greater Antilles prior to the collection of five biting females made by A. E. Pritchard and E. L. Seabrook on Cudjoe Key, Florida, October 13, 1945 (see Pritchard et al., 1947). During an intensive mosquito survey of the Upper and Lower Keys in 1947 and 1948, larvae of *johnstonii* were first collected on Long Key, December 5, 1947, in a temporary rain pool. This pool is similar to many others formed in shallow depressions prevalent in the Key Largo limestone strata of the Upper Keys region, strata which had their origin in coral reefs along the outer edge of the Floridian Plateau (see Cooke, 1945). Larvae of *J. varipes* (Coq.) were obtained by Coffin "from small pot-holes in rocks" at Mount Vernon, Bahama Islands (Shattuck, 1905, p. 276).

The Long Key pool, which is typical of the observed larval habitats of *johnstonii*, was located in the inner edge of a buttonwood (*Conocarpus erecta* L.) transition zone between a hardwood forest and a black mangrove (*Avicennia nitida* Jacq.) brackish-swamp and was filled with a thick mat of purslane sesuvium (*Sesuvium portulacastrum* L.); however, this pool was apparently free of permanent aquatic vegetation. Century plants (*Agave* spp.), typical of xerophytic conditions, were growing abundantly around the borders in the shallow areas, denoting the temporary flooded condition of the locality. A thick growth of Florida poisonwood tree (*Metopium toxiferum* (L.) Krug and Urban), gumbo-limbo (*Bursera simaruba* (L.) Benth), and box leaf eugenia (*Eugenia mytoides* Poir.) intertwined with several species of subtropical creepers surrounded the pool forming a canopy which provided dense shade

[5]In non-flattened specimens Roth (1945, p. 7) noted differences in the apical portion of the claspette of the two species; "however these differences are probably subject to variation and cannot be used to safely separate the genitalia of *ferox* and *horrida*."

throughout the day. Here the mosquito *johnstonii* occurred in association with *Psorophora ferox* (Humboldt), *Deinocerites cancer* Theobald, *Aedes thelcter* Dyar, *A. tortilis* (Theobald), and two undetermined species of *Aedes*. Subsequent collections of mosquitoes in the area revealed the presence of *Aedes taeniorhynchus* (Wiedemann), *A. sollicitans* (Walker), *A. triseriatus* (Say), *A. atlanticus* Dyar & Knab, *Culex nigripalpus* Theobald, *C. atratus* Theobald, *Psorophora confinnis* (Lynch-Arribalzaga) *P. howardii* (Coquillett), *P. pygmaea* (Theobald), and an undetermined species of *Psorophora*.

Larvae of *johnstonii* were found in seven other locations in the Upper Keys chain, three of Long Key, two on Key Largo (Rock Harbor and Tavernier Creek), one on Plantation Key, and one on Lower Matecumbe Key. These were all similar to the above-described typical larval habitat. In addition to occurring in the first type of larval habitat, larvae were collected on Long Key from among dead grass and leaves at the edges of a large borrow pit which was only partially shaded during the day and one larva was taken at Rock Harbon in company with larvae of *D. cancer* Theobald from a crab hole located 8 feet from a typical *johnstonii* pool.

In the Lower Keys chain, formed from Miami ōolitic limestone, the only *johnstonii* larval occurrence was at five locations on Big Pine Key. One area was a large pot hole approximately 12 feet in diameter and 3 feet deep filled to capacity with fresh, clear water. The presence of a species of fairy shrimp suggested the pool had been filled by recent rains. Tall slash pines (*Pinus caribaea* Morlet) and low growing saw palmetto (*Serenoa repens* Small) provided 30 to 40 percent shade. Water hyssop (*Bacopa monnieri* Hayata & Matsum) was submerged and growing on the bottom of the pot hole. The second pot hole in its natural condition was comparable in size and structure to the first, but had been partially filled with soil, trees, and other plants, making this sunlet pot hole a flooded, stagnant pool of odoriferous, decaying vegetation. The third, fourth, and fifth sites, saucer-shaped depressions with not more than 10 inches of water at the deepest points, were similar to the typical larval habitat on Long Key, with the exception of the presence of a growth of sea-oxeye (*Borrichia fructescens* (L.) D. C.). Additional species of mosquito larvae occurring with *johnstonii* on Big Pine Key were *Anopheles albimanus* Wiedemann, *A. crucians* Wiedemann, *Culex pilosus* (Dyar & Knab), and *Uranotaenia lowii* Theobald. At the same time that females of *johnstonii* were collected, adult females of *Wyeomyia vanduzeei* Dyar and Knab were taken biting.

Samples of the water and soil, which demonstrated the presence of varying quantities of the leaf-mold, were tested from each location. The pH reading from the typical site on Long Key was 6.2. At Rock Harbor two localities were tested with the results being 7.2 for an area containing large quantities of decaying organic matter and 8.6 for an area showing a small amount of decomposing material. On one occasion third instar larvae of *johnstonii* were observed in a pool formed by rains flooding a brackish pond. The following day the water had receded 2 inches and *johnstonii* larvae were not to be found even though predators were absent. This observation points to the

fact that brackish conditions may be unsuitable for the larvae of *johnstonii*.

In order to determine the duration of the egg stage and the length of the larval stadia, wild, mated, engorged females were employed for oviposition. On April 26, 1948, 41 females were collected on Lower Matecumbe Key of which seven were allowed to take blood meals before being captured in individual vials stoppered with cotton. These females were placed in 4 x 6 inch screen cages and kept in the laboratory

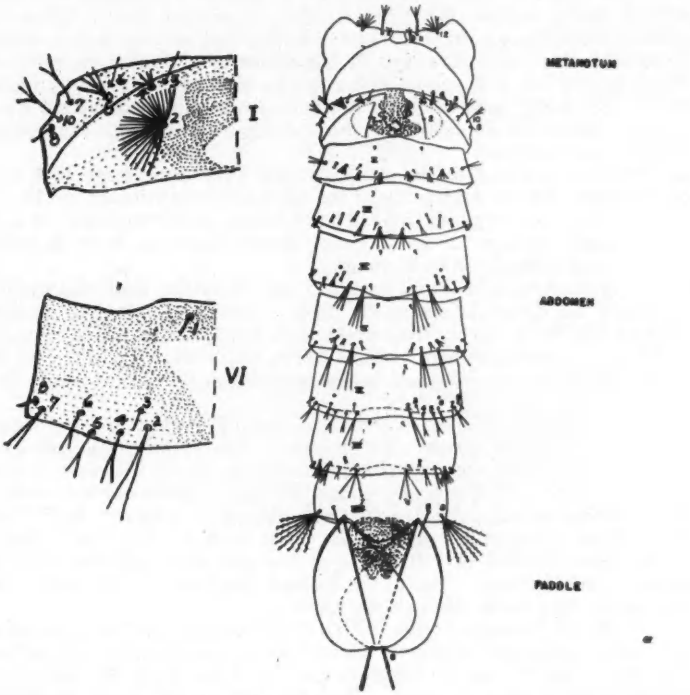

FIG. 3. *Psorophora* (*Janthinosoma*) *johnstonii* (Grabham, 1905). Structure and chaetotaxy of metanotum and abdomen of pupa. The terminology is that employed by Knight and Chamberlain (1948).

under humid conditions. After 6 days only one female remained alive. During this period second blood meals had been refused although the females had opportunities to take blood at various times during the days and nights. On the seventh day the remaining female deposited 13 eggs on damp cellucotton. The eggs were laid singly (fig. 4A) and were shiny black at the time of deposition. These eggs were allowed

to desiccate for 7 days but collapsed when flooded with water for an attempted hatching.

Samples of the soil and leaf-mold from known *johnstonii* pools were flooded in large white pans without successfully collecting eggs or first instar larvae. From field observations it appears that eggs resist hatching when light rains merely dampen the soil, but require being flooded for several hours.

On several occasions at Rock Harbor, first instar larvae were observed 12 to 18 hours following a heavy rain and both first and large second instar larvae were found after continued heavy rains. It appears that the eggs in the lowest area hatched and the larvae molted to second instar while the eggs on the higher elevations were hatching. Wild-caught first and second instar larvae were not successfully reared in the laboratory past the third stadium, while third and fourth instar larvae collected in the field were readily reared to the adult stage under laboratory conditions.

Observations in the field demonstrated that an average of 6 days was required for the emergence of the adults under optimum conditions. The first stadium required from 12 to 18 hours; second stadium, 24 to 36 hours; third stadium, 26 to 40 hours; fourth stadium, 36 to 48 hours; and the pupal stage, 18 to 24 hours.

Coloration of larvae and pupae observed in the field was variable probably due to conditions in the pools. Specimens collected on Long Key and at Rock Harbor from areas of 90 to 95 percent shade appeared to be transparent, grayish, or light brown while those collected on Big Pine Key under conditions of bright sunlight to 25 percent shade were dark brown or black.

On the Keys, as almost everywhere else in Florida, April is normally one of the driest months of the year. The mean precipitation for April at Key West, according to the United States Weather Bureau station records, is 1.29 inches. Since 1940 all Aprils have been recorded at Key West as normally dry with two glaring exceptions: April, 1941, with 13.14 inches and 7 years later, 1948, with 12.83 inches. During April, 1948, a total of 159 larvae and pupae were collected with an additional 60 females. One of the highest biting counts recorded during this study was made late in the month.

Adults of *johnstonii* have a characteristic high-pitched note when in flight. Females, resting or biting, have been collected at various distances from the larval habitats ranging from along the margins of the pool to 1 mile distance. Females were collected at Marathon (Vaca Key) where the larvae were not located, and where a roadside ditch containing the only apparent fresh water in the immediate area did not produce any evidence of larval occurrence.

Males have been collected resting on vegetation or hovering in a swarm over the edge of the densely shaded pools on Long Key and Lower Matecumbe Key. On Big Pine Key, August 5, 1948, two mating swarms of some 35 to 50 males were observed at 4:00 p. m. The males were hovering in a circular mass, 24 to 36 inches in diameter, 3 to 12 inches above the surface of the water. Although males were dispersed when specimens were hand-collected from the mass, they quickly returned to their original formation after each dispersion and

continued to fly in the swarming motion for some 30 minutes. Unengorged females were observed to fly into the swarm while freshly-engorged females rested nearby on the surrounding vegetation.

Until actually feeding, biting females of *johnstonii* are more difficult to capture than *Aedes taeniorhynchus* due to their nervous flight and approach. Nevertheless, despite this they are persistent and vicious biters and will pursue a victim for some distance.

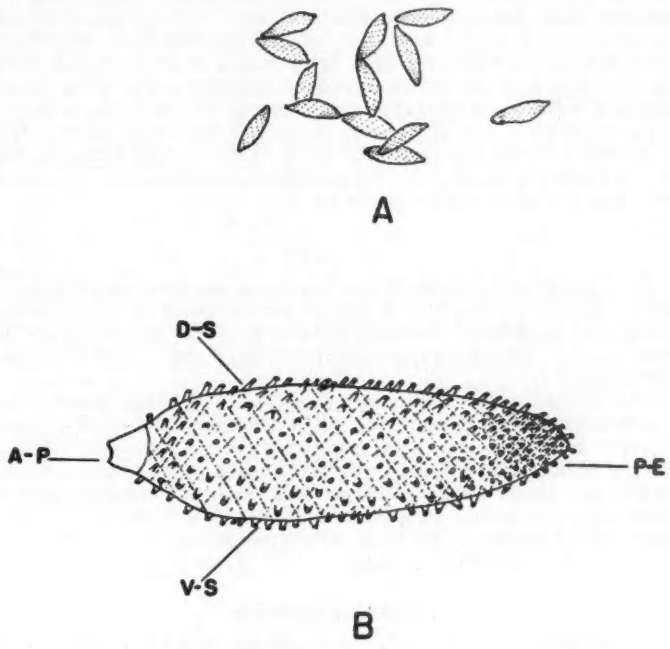

FIG. 4. *Psorophora* (*Janthinosoma*) *johnstonii* (Grabham, 1905). A. Egg mass. B. External structure of egg: A-P.—Anterior pole; P-E.—Posterior end; D-S.—Dorsal surface; V-S.—Ventral surface.

At Marathon on April 14, 1948, twelve females were captured with thirteen *A. taeniorhynchus* during a biting test made by Dr. M. W. Provost, Mr. D. C. Thurman, Jr., and one of the authors. The collection was made in the edge of a wooded strip at 8:30 a. m. under cloudy, windy conditions. Under similar conditions at 2:00 p. m. after a light rain on April 26, 1948, an additional fourteen females were collected with twelve *A. taeniorhynchus*.

Females of *johnstonii* have been found to bite at any time throughout the day. They have been collected in both shade and bright sunlight, on clear or cloudy days as well as during light rains. Although *johnstonii* females were found to bite more frequently under still conditions, they continued to bite when moderate to brisk winds prevailed. As many as 20 to 30 bites per minute have been recorded from numerous tests. On two occasions records of 100 bites per minute have been made, on Marathon at 2:00 p. m., April 28, 1948, and on Plantation Key at 11:00 a. m., August 10, 1948. The females were so aggressive that collectors could not endure the bites for long. On occasion, *johnstonii* has been found to be the major pest mosquito on Marathon and Plantation Keys, and in certain limited instances on these Keys this species has been found to far outnumber *Aedes taeniorhynchus* which is considered to be the most important pest mosquito throughout the Keys.

From December, 1947, through August, 1948, a total of 915 larvae and 80 pupae of *johnstonii* was collected on the Keys from which 35 males and 40 females were reared. An additional 16 males and 357 females were captured while resting or biting.

SUMMARY

Since specimens of *Psorophora* (*Janthinosoma*) *johnstonii* (Grabham, 1905) collected in the Florida Keys demonstrated all the variations in size and coloration which have been found in specimens of both *johnstonii* and *coffini* from their type localities, *P. coffini* is here relegated to synonomy.

The typical larval habitat for *johnstonii* in Florida was found to be a densely shaded, shallow, rain-filled depression, although a number of larvae were collected in deep sunlit pools. Adults were found to bite throughout the day under sunny, cloudy, calm, windy, or rainy conditions. Under local conditions *johnstonii* was recognized as the major pest mosquito, often outnumbering *Aedes taeniorhynchus*, a species which generally has been considered to be the most important pest mosquito of the Florida Keys.

ACKNOWLEDGEMENTS

To Dr. Alan Stone, U. S. National Museum, and Dr. Harry D. Pratt, U. S. Public Health Service, not only for making available type and comparative specimens from respective collections, but for reviewing the manuscript and offering valuable criticism; to Dr. W. V. King, U. S. D. A., Bureau of Entomology and Plant Quarantine, and Dr. W. W. Wirth, University of California, for lending comparative specimens; to Mr. D. C. Thurman, Jr., U. S. Public Health Service, for guidance in all phases of the study; to Dr. M. W. Provost, Florida State Board of Health, and Dr. A. Earl Pritchard, University of California, for reviewing the manuscript; to Miss Lucile Logan, Florida State Board of Health, for assistance in laboratory procedures; and to Dr. Erdman West, Florida Agricultural Experimental Station, for determining the botanical species listed, the authors wish to express their sincere appreciation.

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THE ENTOMOLOGICAL SOCIETY OF AMERICA
PROCEEDINGS OF THE FORTY-FIFTH ANNUAL MEETING

Denver, Colorado, December 18 - 21, 1950

The Entomological Society of America held its forty-fifth annual meeting Monday through Thursday, December 18–21, 1950, in conjunction with the annual meeting of the American Association of Economic Entomologists. Headquarters were at the Shirley-Savoy Hotel. Attendance for the combined meetings totaled over 400. Joint sessions were held with the American Association of Economic Entomologists.

The following sessions of the Society constituted the four-day program:

Monday, December 18

8:30 A. M.—Registration.
10:00 A. M.—Joint Session. Address by the President, A.A.E.E., "The Time Factor in Biological Control," Curtis P. Clausen, U. S. Bureau of Entomology and Plant Quarantine.
1:30 P. M.—General Session; Presentation of papers. President Hayes presiding.

Tuesday, December 19

8:30 A. M.—Joint Session. Invitational papers. Presiding Officers, Wm. P. Hayes, President, E.S.A., and Roy E. Campbell, First Vice-President, A.A.E.E.
1:30 P. M.—Physiology Section. Symposium on Insect Physiology. R. L. Patton, Chairman; O. E. Tauber, Vice-Chairman; Leigh E. Chadwick, Secretary.
1:30 P. M.—Taxonomy Section. Presentation of papers. C. W. Sabrosky, Chairman; R. L. Usinger, Vice-Chairman; C. D. Michener, Secretary.
6:30 P. M.—Cocktail Party and Entomological Banquet and Entertainment.

Wednesday, December 20

9:00 A. M.—Taxonomy Section. Symposium on Insect Morphology and Evolution.
9:00 A. M.—Physiology Section. Presentation of Papers.
1:30 P. M.—Joint Session, Teaching Section A.A.E.E. Chairman, Ephriam Nixon, University of Nebraska.
1:30 P. M.—Physiology Section. Presentation of Papers.
6:30 P. M.—Complimentary Banquet and Entertainment.

Thursday, December 21

9:00 A. M.—Business Session. President Hayes, presiding.

Business Session

President Hayes called the meeting to order and asked for the report of the Secretary.

REPORT OF THE SECRETARY

Executive Committee Activities.

To represent the Entomological Society at various functions, President Hayes made the following appointments: Professor Vasco Tanner to attend the Diamond Jubilee of the Brigham Young University; Dr. S. W. Bilsing, to participate in the inauguration of the new President of Texas A. & M. College; and Professor G. F. Knowlton, to represent us at the installation of the eighth president of the Utah State Agricultural College.

The following committees were appointed during the year by President Hayes:

Program Committee: A. G. Richards, Jr., R. C. Smith, and P. W. Oman, Chairman.

Nominations Committee: C. L. Fluke, D. C. Mote, and H. B. Hungerford, Chairman.

President Hayes and President Clausen of the A.A.E.E. collaborated in the appointment of a joint local arrangements committee of Jim Dutton, F. H. Gates, W. E. McCauley, Hugo G. Rodeck, B. T. Snipes, Claude Wakeland, Vice-Chairman, and George M. List, Chairman.

The Secretary gave information and advisory material to two committees dealing with the classification and use of trained manpower during the present crisis.

The joint Committee on Unification of the national entomological societies submitted its report and this was circularized among the Executive Committee.

Annual Executive Committee Meeting.

The annual meeting of the Executive Committee was held December 17th, 1950, with the following members present: W. P. Hayes, M. T. James, E. G. Lindsley, H. H. Ross, and alternates W. J. Brown and P. W. Oman.

1. Fifty-four new members were elected to the Society.

2. The following members have resigned during the year: Ross H. Arnett, A. J. Basinger, G. M. Bentley, J. H. Evans, Ellsworth Hagen, Kenneth Hobbs, H. H. Incho, Joseph L. King, Esther Hendee Kottke, E. B. Martin, Paul N. Musgrave, Henry Ness, John V. Osmun, D. C. Parman, C. C. Plummer, K. D. Quarterman, E. A. Richmond, W. J. Schoene, Herbert H. Welkden, C. Willemse, C. B. Williams.

3. The following members have been dropped from membership because of failure to pay dues or because they cannot be reached:

T. Allen, R. H. Beatie, F. F. Bibby, R. V. Chamberlin, J. H. Conroy, O. B. Cope, R. H. Crandall, G. O. Faure, W. D. Field, P. Galindo, A. R. Goldberg, T. A. Hart, J. R. Hickman, W. E. Hoffman, M. J. Janes, G. Lobdell, J. F. Mangrum, L. F. Martorell, R. H. Miller, W. P. Nye, F. R. Platt, J. A. Ramos, F. A. Riedel, J. A. Rivero, P. F. Robinson, G. S. Ryan, C. T. Schmidt, G. F. Smith, O. I. Snapp, C. S. Spooner, G. M. Stirrett, R. G. Strong, H. D. Thomas, O. P. Wilkins, G. C. Wood.

4. No action was taken on Fellows pending the settling of the amalgamation question.

5. The Society has lost by death during the year the following members: C. F. Adams, P. N. Annand, H. S. Barber, C. Brayton Eddy, L. O. Howard, J. F. Illingworth, J. M. Robinson, Paul E. Telford, L. P. Wehrle, Robert M. Yergason.

6. Two members were elected to the Thomas Say Foundation to serve until 1952: R. L. Usinger, C. D. Michener.

7. Three members were elected to the Editorial Board to serve until 1953: G. S. Walley, A. B. Gurney, F. M. Carpenter.

8. It was voted to send $100.00 to the Zoological Society of London for the support of Zoological Record.

9. The next annual meeting will be held in Cincinnati, Ohio, December 9–13, 1951.

10. The following officers were elected for the Physiology Section: Chairman, LEIGH CHADWICK; Vice-Chairman, V. G. DETHIER; Secretary, R. L. METCALF.

11. The following officers were elected for the Taxonomy Section: Chairman, C. D. MICHENER; Vice-Chairman, W. H. ANDERSON; Secretary, G. P. HOLLAND.

12. C. W. SABROSKY proposed that the Society affiliate with the Society of Systematic Zoology. After considerable discussion, it was moved to table this proposal until the matter of amalgamation of the entomological societies had been settled.

Special Executive Committee Meetings.

On December 18th a special meeting was called to discuss the report of the Joint Committee on Amalgamation. The same members were present, with the addition of alternates C. W. SABROSKY and C. E. MICKEL. It was agreed that the Executive Committee approved the general plan for amalgamation of the two societies. A considerable number of individual points were brought up concerning the proposed new constitution, and a list of questions and suggested changes made.

On December 20th our Executive Committee met with the Executive Committee of the American Association of Economic Entomologists and with the Joint Committee on Amalgamation, and discussed the various matters brought up at the preceding meeting. Out of it emerged a corrected proposed constitution for the new society which received the whole-hearted support of both Executive Committees and the Joint Committee. Plans were outlined for bringing this before the bodies of the two organizations with the thought that a vote would be taken on the matter sometime during the year and if carried, the project would be effective as of January 1st, 1952. Dr. Mickel was requested to present this to the business meeting the following day.

Respectfully submitted,

HERBERT H. ROSS, *Secretary.*

On motion, the Secretary's Report was adopted as read.

TREASURER'S REPORT

DECEMBER 6, 1949 – NOVEMBER 20, 1950

CURRENT FUND

Balance on hand December 6, 1949		$ 1,632.22
Receipts		9,740.34
Total		$11,372.56
EXPENDITURES		
Annals (3 numbers)	$ 4,924.57	
Expense of Secretary-Treasurer's office	194.57	
Bank charges	0.85	
Travel expense	307.54	
To Zoological Society of London	100.05	
Total	$ 5,527.58	
Balance in bank, November 20, 1950	5,844.98	
Total		$11,372.56

PERMANENT FUND

Balance on hand, December 6, 1949	$ 4,636.98
Interest and coupons	11.44
Balance on hand November 20, 1950	$ 4,648.42
Liberty Bond	50.00
Total	$ 4,698.42

TOTAL RESOURCES OF SOCIETY

Balance in Current Fund	$ 5,844.98
Balance in Permanent Fund	4,698.42
Total	$10,543.40

Respectfully submitted,
HERBERT H. ROSS, *Treasurer.*

On motion, the Treasurer's Report was adopted as read, subject to approval by the Auditing Committee.

REPORT OF THE MANAGING EDITOR

The number of acceptable manuscripts received during the current year has been approximately sufficient to fill one volume of the ANNALS. Consequently, the backlog remains approximately the same as it was at the beginning of the year. This means about a year's delay in publication. Manuscripts have been reviewed more critically than in previous years. This has aided in holding the backlog to a level and will aid in maintaining higher standards for the ANNALS. Another factor of some importance is the tendency toward an increase in the number of pages for which publication costs have been paid by authors in return for immediate publication, that number for 1950 being about 51.

Some changes in the editorial set-up of the ANNALS seems desirable, but it is the opinion of the Editorial Board that the present time is hardly the opportune one, in view of the proposed amalgamation of the Society with the American Association of Economic Entomologists. Among the changes being considered are a change in format to a two-column page, the acceptance of advertising, a change in policy to eliminate free reprints and possibly to allow instead the equivalent of a page of cuts, and a reorganization of the Editorial Board itself. These changes would have as their primary objectives, (1) an increase in editorial efficiency, (2) prompter publication, and (3) higher standards. Another question to be answered is whether members' publication needs should be subordinated to reader interest. The opinions of members of the Editorial Board have been solicited in these matters, but the Editor will welcome expression of opinion from others.

The following is a financial report for the year.

FINANCIAL STATEMENT

NOVEMBER 15, 1949, TO NOVEMBER 2, 1950

Bank balance, First National Bank of Pullman, November 15, 1949	$2,533.82
RECEIPTS	
Cash on hand, November 15, 1949	6.90
From authors, for cuts and reprints	832.31
From the Columbus office, non-member subscriptions and sales	2,453.16
From the Rockefeller Institute, publication costs	102.00
From the Pan American Sanitary Bureau, publication costs	316.42
Total	$6,244.61
DISBURSEMENTS	
Stationery and supplies, including new typewriter for the Columbus office	$ 122.44
Engraving	719.18
Stenographic and addressograph service	331.00
To Spahr and Glenn, reprints paid by authors	92.49
Postage	100.76
Travel expenses of the Managing Editor to the Tampa meetings	294.32
Check returns and refunds	10.05
Transferred to H. H. Ross, Secretary-Treasurer	3,500.00
Total	$5,170.24
Bank balance, First National Bank of Pullman, November 2, 1950	1,074.37
	$6,244.61

Respectfully submitted,
MAURICE T. JAMES, *Managing Editor.*

The report of the Managing Editor was adopted as read, subject to approval by the Auditing Committee.

It was moved and seconded that Dr. Knull and the Secretary look into the situation of Annals reprints, and be empowered to take whatever action seems best for the benefit of the Society. Motion carried.

REPORT OF THE AUDITING COMMITTEE

We beg to make the following report regarding the Society's accounts:

H. B. MILLS examined the books of the Treasurer, H. H. ROSS, and MORRIS ROCKSTEIN examined the accounts of the Managing Editor, M. T. JAMES, and these were found to be balanced and in good order. We have not yet had an opportunity to examine the books of the Treasurer of the Thomas Say Foundation but will attempt to do this as soon as possible.

Respectfully submitted,

B. ELWOOD MONTGOMERY,
MORRIS ROCKSTEIN,
H. B. MILLS, *Chairman*.

On motion, the report of the Auditing Committee was adopted as read.

REPORT OF THE REPRESENTATIVE OF THE SOCIETY IN THE DIVISION OF BIOLOGY AND AGRICULTURE, NATIONAL RESEARCH COUNCIL

The undersigned attended the annual meeting of the Division of Biology and Agriculture on May 9, 1950, at Washington, D. C., as representative of the Entomological Society of America. The following portions of the program were of special interest from the standpoint of entomologists.

I. *Functions of the National Research Council.*

Dr. D. W. Bronk, then President of the National Academy of Sciences, presented a challenging and informative discussion of this subject, listing five major functions or fields of activity of the NRC.

A. Everything that it can do to stimulate and to further research.
   1. Procurement of funds for the support of research.
   2. Activity of Committees for the study of problems in various fields of science.
   3. Publication of monographs which disseminate information on scientific research.
   4. Consideration of problems of scientific abstracting, etc., because of the great and mounting accumulation of scientific information.

B. Assistance in the training of young scientists through the fellowship programs.

C. Advice to governmental agencies.

D. Advice to private organizations on the support and utilization of scientific research.

E. Activities that unite or coordinate scholarship from various scientific fields.

Remarks following Dr. Bronk's talk expressed the view that there is much lack of understanding of what NRC is, how it is operated, and what it does. As an outgrowth of this discussion, a resolution was prepared and endorsed by the Division, suggesting that a short brochure on the organization and functions of NRC be prepared and widely distributed.

II. *American Institute of Biological Sciences (AIBS).*

The AIBS is at present composed of 16 member societies, with two affiliates and two associates. Considerable progress was reported on the "Handbook of Biological Data" which the Institute is sponsoring. "The AIBS is prepared to make arrangements for national meetings of such member societies as desire it," and the annual meetings of a number of the member societies were held in Columbus, Ohio, in September, 1950. Plans are already under way for a similar meeting in Minneapolis in September, 1951. Many of the societies involved have hitherto met with the AAAS in the Christmas meetings.

III. *The Fulbright Program.*

The Division of Biology and Agriculture cooperates in the operation of this program by assisting in the primary screening of applications for awards for teaching and research. The extent of the program, and of the work involved in the proper consideration of applications, is illustrated by the fact that for the academic year 1950–51, there were nearly 1500 applications for the approximately 250 awards, of which 99 awards were in the Natural Sciences. The number of applications was double that of the previous year.

In Entomology, there were five applications, of which four were recommended by the Division's Committee after primary screening, but none were recommended by the Conference Committee which makes the final recommendations to the Department of State. In the related field of Zoology, there were 22 applications, 20 passed the primary screening, and five (nearly 23%) were finally recommended by the Conference Committee.

IV. *The National Research Council Fellowships.*

Last year there were 149 applications for 17 available awards in the Natural Sciences, 46 applications were considered by the Division of Biology and Agriculture, and 12 of these were recommended for fellowships. Three were finally awarded, in the fields of Genetics, Mycology, and Microbiology. Of the other 14 awards, five were in Chemistry, five in Physics, two in Geology, and two others.

Your representative calls attention to two points under III and IV: (1) the large number of applications for the available awards, and (2) the small number of applications in the field of Entomology. If entomologists wish greater recognition by NRC and increased participation in research grants and similar activities, they must first of all apply. More important, the applications that are made must be well-presented and deserving programs that will unquestionably merit serious consideration by selection committees in the face of a large number of strong applications from other fields, for the competition is obviously severe.

Respectfully submitted,

CURTIS W. SAVROSKY.

DR. C. D. MICHENER gave an oral report on the year's activities of the Joint Committee on Entomological Nomenclature.

REPORT ON UNIFICATION OF THE NATIONAL ENTOMOLOGICAL SOCIETIES

Dr. Mickel reported on the action of the Executive Committee and of the Joint Committee on Unification. He read the proposed constitution and by-laws of the proposed united organization which would be known as The Entomological Society of America. He further recommended that this report be considered the necessary notice of change required in the constitution. Dr. Mickel's report was followed by a great deal of discussion in which individual points of doubt were cleared up regarding the contents of the constitution.

It was moved and seconded that this report be adopted, and that the officers be authorized to submit copies of the proposed constitution and by-laws to the entire membership within six months; and further authorized to present a single ballot on the acceptance of the proposed constitution. Such merger, however, would be contingent upon acceptance by a two-thirds favorable vote of the ballots cast in each society.

Motion carried.

It was moved that the incoming President appoint a representative to the Amsterdam Congress.

REPORT OF THE RESOLUTIONS COMMITTEE

Having had such a delightful and stimulating meeting of the Entomological Society of America in Denver, now therefore, be it resolved:

1. That the Society express our appreciation to all those who have labored to make this one of the most successful and enjoyable meetings. We would like to thank the local arrangements committee composed of J. DUTTON, F. H. GATES, W. E. MCCAULEY, HUGO G. RODECK, B. T. SNIPES, C. WAKELAND, and G. M. LIST, Chairman, and the Program Committee, namely, A. G. RICHARDS, R. C. SMITH and P. W. OMAN, Chairman, for their untiring efforts in arranging such a program and for providing entertainment for the wives of our members and guests.

2. That we would express, further, our thanks to the Julius Hyman Co. and the Shell Chemical Corporation of Denver, in particular, and to all of the other industrial organizations who contributed to assist the local committees.

3. We would like to thank also the Cosmopolitan and Shirley-Savoy Hotels for the hospitality extended.

4. We would acknowledge again the efficient service of our Managing Editor, MAURICE T. JAMES, and HERBERT H. ROSS, both of whom have done most excellent work in the affairs of our Society. We would direct that a letter expressing our thanks for secretarial aid be sent to the proper authorities of the State College of Washington and the Illinois Natural History Survey.

5. We would like, especially, to thank DR. C. B. PHILIP for presenting the invitational public address on behalf of the Society.

6. Be it resolved that the Society note with sincere regret the loss by death of DR. L. O. HOWARD, Honorary Fellow, and all of those other members lost by death during the past year, and we would suggest that an expression of our sympathy be sent to the families of the deceased.

Respectfully submitted,

G. F. FERRIS,
L. J. STANNARD,
HARRY H. KNIGHT, *Chairman*.

On motion, this report was adopted as read.

REPORT OF THE NOMINATING COMMITTEE

Your Nominating Committee desires to present the following:

For *President*.....J. CHESTER BRADLEY
First Vice-President.....G. F. FERRIS
Second Vice-President.....H. A. SCULLEN
Secretary-Treasurer.....H. H. ROSS
As member of the Executive Committee.....S. W. FROST
Councilor to the American Association for the Advancement of Science.....T. H. HUBBELL (2 year term)

Respectfully submitted,

C. L. FLUKE,
DON C. MOTE,
H. B. HUNGERFORD, *Chairman*.

It was moved that the Secretary be instructed to cast a unanimous ballot for these officers. Motion carried.

After a call for further business from the floor, the meeting adjourned.

REPORT OF THE JOINT COMMITTEE ON THE PREPARATION OF A HISTORY OF ENTOMOLOGY IN WORLD WAR II

The Committee is pleased to report that substantial progress has been made on the preparation of a History of Entomology in World War II, and it is now hoped that the first draft of the manuscript can be placed in the hands of the Executive Committee early in 1951. Two members of the Joint Committee (Knipling and Oman) have reviewed the first draft of the "History." It is planned to have the first complete draft of the "History" reviewed in detail by the Joint Committee before the manuscript is referred to the Executive Committee.

Respectfully submitted,

STANLEY W. BROMLEY,
RALPH W. BUNN,
E. F. KNIPLING, *Co-Chairman*,
PAUL W. OMAN, *Chairman*.

NEW MEMBERS ELECTED TO THE SOCIETY

ABRAMITIS, WALTER W., Dept. Zoology & Entomology, Iowa State College, Ames, Iowa.
ADAMS, PHILLIP A., 2629 Haste Street, Berkeley 4, California. *Neuroptera.*
ARNAUD, PAUL HENRI, JR., 60 Woodrow Street, Redwood City, California.
AYCOCK, JAMES F., 2324 Garfield Street, Hollywood, Florida.

BOUSH, GEORGE MALLORY, Dept. of Zoology & Entomology, Ohio State University, Columbus, Ohio.
BURNHAM, STANLEY, Box 504, San Saba, Texas.
BUSHNELL, RALPH J., University of Connecticut, Storrs, Connecticut.

CLARK, ELTON L., 930 Tower Road, Ithaca, New York. *Toxicology and Physiology.*
COOK, EDWIN FRANCIS, Dept. of Entomology, University of Minnesota, St. Paul, Minnesota. *Diptera.*
COOK, PAUL P., University of Kansas, Department of Entomology, Lawrence, Kansas.

DAVIES, JOHN E., State Dept. of Agriculture, Salem, Oregon.
DAVIS, NORMAN T., Room 407 Science Hall, Iowa State College, Ames, Iowa.
DIAS, D. P. DE SOUZA, 119 So. Baker Hall, Ithaca, New York. *Ecology of Bombidae.*
DOWNES, DOUGLAS JOHN, Dept. of Biology, University of Florida, Gainesville, Florida.
DOWNEY, JOHN C., Dept. of Invertebrate Zoology & Entomology, University of Utah, Salt Lake City, Utah.

ELLER, JAMES GERALD, Box 324, Western Carolina Teachers College, Cullowhee, North Carolina. *Mayflies.*
ELMORE, CHRISTOPHER M., JR., Apt. 7-C, 4100 Peachtree Road, Brookhaven, Georgia.

FLYNN, JOHN EDWARD, Comstock Hall, Cornell University, Ithaca, New York. *Spiders.*
FRAENKEL, GOTTFRIED SAMUEL, Dept. of Entomology, University of Illinois, Urbana, Illinois. *Physiology.*

GREENE, JAMES F., N. C. Dept. of Agr., Raleigh, North Carolina.

HARVEY, TOMMY LARKIN, 1638 Laramie Street, Manhattan, Kansas.
HOWDEN, HENRY F., 1608 Benehan Street, Raleigh, North Carolina.
HULL, WILLIAM B., Lt., MSC, USN, Nav. Med. Res. Inst., Bethesda 14, Maryland. *Mosquitoes.*

JOHNSON, DALE E., Box 734, College Station, Pullman, Washington.

KELLEN, WILLIAM RANDEE, 5138 North Mason Ave., Chicago, 30, Illinois.
KHALAF, KAMEL TOMA, Dept. of Zoology, University of Oklahoma, Norman, Oklahoma. *Culicoides (Diptera).*
KOHLER, CHARLES E., P.H.S., Region IX, 9 Equitable Bldg., Denver 2, Colorado.
KRALL, JACK L., N. Y. State College of Forestry, Dept. of Forest Entomology, Syracuse, New York.

LEIGH, JOHN R., P. O. Box 1, Mposa, Zululand, Natal, Union of South Africa.

MCCAULEY, WILLIAM E., 2095 Bellaire, Denver, Colorado.
MEAD, FRANK WALDRETH, 2286 Indianola Avenue, Columbus 2, Ohio.
MILLER, WILLIAM VAL, FPHA 538-2, West Lafayette, Indiana.
MURPHY, DANIEL R., Dept. of Entomology, University of Arizona, Tucson, Arizona. *Leafhoppers.*

NAMBA, RYOJI, University of Minnesota, Division of Entomology and Economic Zoology, University Farm, St. Paul, Minnesota.
NEILSEN, LEWIS T., Biology Division, University of Utah, Salt Lake City, Utah. *Mosquitoes.*
NOGUEIRA-NETO, PAULO, Av. Cidade Jardim 264, Sao Paulo, Brazil. *Meliponida.*

REED, HORACE BEECHER, JR., 2601 Chillicothe St., Knoxville 16, Tennessee.
REYNOLDS, 1ST LT. DANIEL JOSEPH, MSC, Second Army Area Medical Lab., Fort George C. Meade, Maryland.
ROTH, VINCENT D., Ent. Dept., Oregon State College, Corvallis, Oregon.
RYCKMAN, RAYMOND E., School of Tropical Medicine, Loma Linda, California.

SCHUDER, DONALD L., Dept. of Entomology, Purdue University, A.E.S. Annex, W. Lafayette, Indiana. *Ornamental insects.*
SCOGGIN, JOHN K., Pest Control Laboratory, DuPont Experiment Station, Wilmington, Delaware.
SHANKLAND, DAN L., University of Illinois, Dept. of Entomology, Urbana, Illinois.
SHOUMATOFF, NICHOLAS, Box 333, Bedford, New York.
SIMEONE, JOHN B., N. Y. State College of Forestry, Syracuse, New York.
SPANGLER, PAUL JUNIOR, Ohio University Trailer Site A-9, Athens, Ohio.
SWEADNER, WALTER R., Curator of Entomology, Carnegie Museum, 124 Elysian Street, Pittsburgh 6, Pennsylvania. *Lepidoptera.*

TAYLOR, PHILIP SEYFANG, Ent. Dept., University Farm, St. Paul, Minnesota.
THOMSON, J. RICHARD, University of Chattanooga, Chattanooga 3, Tennessee.

WALKER, DAVID W., 503 McKenzie, Pullman, Washington.
WHITE, JIMMY R., Dept. of Entomology, University of Kansas, Lawrence, Kansas.
WOODLAND, JOHN TURNER, 49 Ardsmoor Road, Melrose 76, Massachusetts. *Insect enbryology and histology.*

YOUNG, FRANK N., JR., Dept. of Zoology, Indiana University, Bloomington, Indiana.
YOUNG, JOSEPH HARDIE, 239 Hawthorne Ave., Palo Alto, California. *Insect embryology.*

OBITUARY

DR. LAWRENCE PAUL WEHRLE died very suddenly on October 23, 1950, in his home in Tucson, Arizona. He had been in the Department of Entomology in the University of Arizona for twenty years.

Dr. Wehrle was born in Osage county, Kansas, on July 4, 1887, and spent his early life on a farm near Scranton, Kansas. He received both his B.S.A. and his M.S. degrees from Kansas State College at Manhattan, Kansas. From there he went to Cornell University where he received his Ph.D. degree and remained there to do both teaching and research in the Entomology Department until 1930. In that year he came to the University of Arizona where he remained until his death.

Dr. Wehrle was an enthusiastic entomologist and enjoyed his teaching and his research. He was fascinated with the insects of Arizona and was especially interested in the aphids and scales of the state. He was a kindly man, always ready to help his students, his colleagues or anyone who asked with their insect problems. The extent of his knowledge of general entomology was amazing. The relations of insects with the virus diseases of plants was occupying much of his attention at the time of his death.

He belonged to numerous entomological societies and to Sigma Xi and Alpha Zeta. He was a fellow of the A.A.A.S. He was a quiet, faithful member of the Methodist church.

He is survived by his wife, Helen Lason Wehrle, two sons, Dr. Paul F. Wehrle and Lawrence L. Wehrle, a daughter, Mrs. J. W. Meehan, and four grandchildren.

HELEN LASON WEHRLE.

BOOK NOTICE

CONSERVATION OF NATURAL RESOURCES, edited by GUY-HAROLD SMITH. xii+552 pages, 175 text figures. John Wiley & Sons, Inc., 1950. Price $6.00.

In accordance with the broader cognizance and need for conservation the second edition of "Our natural resources and their conservation" by the late A. E. Parkins and J. R. Whitaker has been rewritten. This new book, "Conservation of natural resources," is edited by Guy-Harold Smith, Ohio State University, who points out in the preface that Professor J. R. Whitaker, the successor of Professor A. E. Parkins, relinquished editorship due to other commitments. Smith also points out that, "The book retains the general organization of the original edition though most of the chapters have been entirely rewritten. Nine new authors have been added to the list of contributors." These men have done an outstanding job presenting specialized knowledge of particular resources.

This is a general book compiling the major aspects of conservation of our natural resources. The important divisions of land and crop, forest, water, mineral, wildlife, and recreation are treated broadly. A conservation objective is maintained as the problems arising from the wasteful use of the resources of the United States are discussed with regard to what is needed, what is being done, and what should be done. A good inventory of the resources is included in the discussions. A readable history of various facets in the development of conservation in America and the effect of resources on our way of life is discussed. The treatment of problems in conservation of resources and the importance of resources in maintaining our place in the economic world is presented. The authors recognize that conservation is an interrelated field and good conservation of soil, for instance, also involves conservation of other resources as well. The last two chapters point out that there should be coordinated planning on local, state and national levels, for unless planning is farsighted and all parts of the problems are considered, efforts to meet particular problems in one resource may nullify conservation efforts in another and in effect be more detrimental than helpful. An example is the building of dams on all western rivers which could destroy a valuable fisheries resource. The book points out the great need for an integrated program in conservation training. All men training for special fields should have a basic and general knowledge before specializing. It is stressed that the time for conservation is now, while we still have appreciable resources, and the knowledge gained through study and research should be applied to husband their use for the greatest possible period of time.

A text written by 20 authors and having subject matter as broad a scope as conservation will certainly have omissions, show discontinuity between chapters, and miss many details. These weaknesses will vary directly in importance with the interests of the reader. On p. 84 William A. Rockie states, "All the 48 states have enabling acts, and more than 75 per cent of the farms in the United States now are within organized soil conservation districts." To be sure, this is a noteworthy accomplishment, but the same writer points out on p. 86 that "A serious lag between lip acceptance and completed application still exists." It should also be pointed out that there is little if any practical value to wildlife in the present SCS programs. Lands classified for wildlife use are little more than worthless since it is generally accepted that good land is necessary to support good wildlife populations, and good land use spells integration and multiple use of land. In a discussion of tree crops the major place is given to exotics. In discussing reclamation of wet and overflow lands, George J. Miller, p. 147, states that "Action should be taken only after scientific investigation and careful planning based on a broad view of the problem and of the general welfare." Actually commercial or private interests usually determine drainage ventures. No mention is made of the possible effect of drainage on water tables. The editor, p. 175, discusses higher yields per acre by the use of improved hybrid seeds. However, he does not point out that such hybrids take nutrients out of the soil at an

accelerated rate and must be replaced if high yields are to continue. It is doubtful whether the reader will grasp the relation between the agricultural prospect and conservation; it sounds more like a chapter on economics. The chapter on forest conservation does not mention the harmful effects of rodents, their ecology or any suggested control measures. On p. 211 the spruce budworm is listed as a major insect enemy. On p. 387 (incorrectly indexed as p. 287) Dambach states, "Forest insects such as the spruce budworm . . . and many others have been controlled." The history of the spruce budworm in Colorado and elsewhere shows that it has not been controlled, and as for one of the "many others," virtually all Englemann spruce over large areas has been annihilated by the Engelmann spruce beetle. Range management and woodland grazing are merely mentioned on pp. 212 and 213. The chapter on water power and its conservation should more accurately be entitled water power and its development. Generally, the chapter on conservation of wildlife is well written. On p. 406 Dambach states, ". . . and pheasant, which are able to spread out quickly into the surrounding territory, are tolerant of crowding, and can be maintained on cheap land." The term territory is misused, I doubt that pheasants are tolerant of crowding, and it is highly improbable that this bird can be maintained on cheap land. The chapter on fisheries for the future would be better if at least a brief discussion of the lamprey and its significance to the Great Lakes fisheries were included.

Although editor Smith states in the preface that, "The language of despair may be evident here and there and may reflect the author's genuine pessimism about the resource situation," the reader is left with a feeling of optimism concerning the status and management of our natural resources. This is my greatest criticism of the book, for we have actually succeeded in exploiting our resources at a breakneck pace unequalled by any other peoples of the earth, and with another war looming on the horizon the outlook for our natural resources is about as gloomy as can be imagined.

The format of this book is good, there is a very good index, the illustrations are well chosen and placed at the reader's convenience, and the style is readable. It is the best book of its kind available today.—IRVEN O. BUSS.

ATLAS OF THE SCALE INSECTS OF NORTH AMERICA, VOL. V, by GORDON FLOYD FERRIS. vii+278 pp., 108 full page figures. Stanford Univ. Press. 1950. Price, $7.50.

The appearance of the fifth of the eight projected parts of this important work is good news. The same careful work and detailed illustration which characterizes the earlier parts of this series are to be seen in the present volume. Some important changes, however, are to be noticed. The original plan of issuing separate leaflets, each devoted to a single insect, apparently did not have a reception which would justify the waste of space which such a plan would necessitate in the bound series; consequently, the "series" have given way to the more orthodox "volume." This has made possible the inclusion of some material, in the form of explanatory sections and partial keys, which otherwise would have been impractical.

The present volume covers about half the Pseudococcidae which the author has had an opportunity to study. The purpose, as in the preceding parts, is to clarify the status of species; consequently, no attempt has been made to include all new ones. New generic names are proposed when necessary to round out the classification.—M.T.J.

NOTICE TO MEMBERS AND CONTRIBUTORS

The Annals of the Entomological Society of America, published by the Society quarterly, includes the Proceedings of the Annual Meetings and such papers as may be selected by the Editorial Board.

Papers should ordinarily be submitted directly to the Editor. However, they may be submitted to any member of the Editorial Board, especially where such member is particularly qualified in the subject matter of the paper.

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